I AM NOT AN ADVOCATE FOR FREQUENT CHANGES IN LAWS AND CONSTITUTIONS. BUT LAWS AND INSTITUTIONS MUST GO HAND IN HAND WITH THE PROGRESS OF THE HUMAN MIND. AS THAT BECOMES MORE DEVELOPED, MORE ENLIGHTENED, AS NEW DISCOVERIES ARE MADE, NEW TRUTHS DISCOVERED AND MANNERS AND OPINIONS CHANGE, WITH THE CHANGE OF CIRCUMSTANCES, INSTITUTIONS MUST ADVANCE ALSO TO KEEP PACE WITH THE TIMES. WE MIGHT AS WELL REQUIRE A MAN TO WEAR STILL THE COAT WHICH FITTED HIM WHEN A BOY AS CIVILIZED SOCIETY TO REMAIN EVER UNDER THE REGIMEN OF THEIR BARBAROUS ANCESTORS

—THOMAS JEFFERSON

THE CONTROL OF
ATOMIC ENERGY

A Study of Its Social, Economic, and Political Implications

by

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and

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The quality of the materials used in the manufacture of this book is governed by continued postwar shortages.

To

SENATOR BRIEN D. MCMAHON

and

CONGRESSWOMAN HELEN GAHAGAN DOUGLAS

Two of the people's representatives
who saw far and who saw clearly

Preface

On August 6, 1945, the first atomic bomb fell on Hiroshima. A little less than a year later, on July 30, 1946, the McMahon-Douglas Atomic Energy Act, designed to control and develop the forces harnessed in this unparalleled instrument of destruction, was signed by the President. While it is difficult to compare a political event to a scientific discovery, the Atomic Energy Act in its impact on social, economic, and political circumstances is an event comparable in importance to the successful release of atomic energy itself.

The Act is broad in sweep and bold in conception. Most striking is the extent to which both Congress and the President in this instance rejected the cautious and timid voice of tradition and paid heed instead to the radical demands of this tremendous scientific eruption. The Act represents an attempt to lay out a complex blueprint of controls on the basis of present knowledge, incomplete though it is on the scientific side and almost nonexistent in the fields of social science, economics, and politics. The decision to draft legislation on such slender foundations was not made without reluctance; it met heavy opposition in Congress and among those members of the Executive Branch who believed that until much more was known about atomic energy its control and development should remain with the War Department, which had well demonstrated its capacities as manager and steward of the new resource. In most people's minds, however, there seemed no alternative to setting up machinery for the civilian control and development of atomic energy on the basis of facts already known. The military value of atomic energy had been fearfully demonstrated; the need for continued research to develop medical and other uses of fissionable substances was understood; scientists had given their assurance that the realization of atomic power could in no sense be regarded as remote.

While Congress was considering legislation for the domestic control and development, steps were being taken on the international level, beginning with the Acheson-Lilienthal report, to evolve a system of international controls directed on the one side against the use of atomic energy for military purposes and on the other toward its rapid development in the interests of world prosperity and peace. Especially in view of the international aspects, it seemed essential to fit the control and development of atomic energy permanently into the framework of governmental functions and national planning. It is clear that this objective could not have been attained had controls been permitted to remain with the military departments under a sign of tentativeness and uncertainty.

This study is an attempt to analyze the meaning of the Act, to interpret its contents, and to evaluate, so far as is presently possible, some of its major social, economic, and political implications. Although both my collaborator and I are lawyers, circumstances compelled us in discussing almost every portion of the Act to go considerably beyond a bare legal interpretation of its provisions. The scope of the legislation must be our justification for venturing into professional fields in which we can pretend to no special training or competence. The Act establishes a gigantic administrative machine for managing the operations of an industrial empire extending over many states, employing tens of thousands of employees, and running at a current expenditure rate of over 500 million dollars a year. But this is only part of the responsibility of the Atomic Energy Commission. It must make policy decisions and regulations in fields as diverse as the following: major branches of industry and technology, including mining, transportation, engineering, and manufacture; scientific research in university and industry; patents, insofar as these are related to inventions and discoveries in atomic energy; the development of atomic power; the licensing of all devices utilizing atomic energy or fissionables; the control and dissemination of all information relating to nuclear physics and derivative technology; the development of the military applications of atomic energy; control of materials involved in the production of fissionable substances.

Each of these activities raises issues of almost unprecedented complexity and significance for the American people. In drafting the Atomic Energy Act Congress was fully aware of the scant nature of the relevant data at hand. Future experience undoubtedly will reveal in many respects the inadequacy of present planning. Our present position is well characterized by Locke's lines: "In the greatest part of our concernment God has afforded us only the twilight, as I may so say, of probability, suitable, I presume, to that state of mediocrity and probationership He has been pleased to place us in here."

Not only is it fair to assume that the Atomic Energy Act will be amended when Congress concludes that the circumstances demand change, but it is abundantly clear that the Atomic Energy Commission, with its wide range of quasi-judicial and quasi-legislative functions, will enlarge enormously the scope of the Act by administrative interpretations and by regulation. The shape of these changes can scarcely be foreseen. We have made the attempt nonetheless to foreshadow certain principal avenues of development and to evaluate the Act from the standpoint of its flexibility and adjustability to new factors and circumstances.

Throughout the genesis of the legislation I was permitted to participate in all phases of the work. As head of the Science Division of the Office of War Mobilization and Reconversion, I acted as White House adviser on science and atomic energy legislation. Later I was appointed counsel to the Senate Special Committee on Atomic Energy, serving in this capacity throughout the Committee's existence. This was a gratifying, if on occasion hectic, experience. It afforded a unique opportunity to observe the workings of both the Executive and Legislative Branches of the government in coping with an immensely difficult and novel series of problems. In carrying out my official duties I was fortunate in having the able assistance of Byron S. Miller, my collaborator in this volume, formerly associate general counsel of the Office of War Mobilization and Reconversion. Both of us were privileged to assist Senator Brien McMahon in the drafting of his bill, the measure that after revision by the Senate Special Committee was passed by

Congress and became the Atomic Energy Act of 1946. I had the advantage also of working with Congresswoman Helen Gahagan Douglas, a true representative of the people, who introduced Senator McMahon's bill in the House of Representatives and whose invaluable support contributed substantially to its final adoption.

The leadership and the foresight of Senator Brien McMahon in adhering to the basic principles of the bill that he introduced originally will, I suspect, never be fully appreciated. In the confusing battle over the bill his significant role tended to become obscured. That is not to underestimate the labors of many others, especially such members of the Senate Special Committee as Senators Vandenberg and Millikin, in breaking the path for acceptance of the measure finally adopted. But most notably in the beginning Senator McMahon stood alone and fought alone for those essential features of the legislation that were finally upheld. The American people are in debt also to Representative Helen Gahagan Douglas, to other members of Congress, and to those plain citizens who with stout heart, vision, and energy devoted themselves to the seemingly hopeless task of securing passage of the Atomic Energy Act. The preservation of what is good in the Act is due to them; its weaknesses reflect the limited powers of men rightly to assess the present and to predict the future.

I am under heavy obligation to many of my colleagues and friends for their ideas, their suggestions, their counsel, and their advice throughout my association with the problems of atomic energy, including the writing of this book. In particular, everything that appears in these pages has been improved for having come under the scrutiny of the lucid mind of my friend and former colleague Alexander Daspit. His contribution is poorly described by the few words that I write here. For invaluable scientific advice and insight I am indebted to my friend Dr. Edward U. Condon, formerly my colleague when he served as scientific adviser to the Senate Special Committee on Atomic Energy and now director of the National Bureau of Standards. I have benefited by the valuable criticism and appraisal of another colleague and friend, Professor Thomas I. Emerson of the Yale University Law School.

Mr. Nathaniel H. Goodrich, a former associate, has made a significant contribution in the appendix to the chapter on control of information, wherein appears for the first time, to my knowledge, an exposition of the legislative evolution of the Espionage Act. Mr. Morris Leikind, associate in science at the Library of Congress, has prepared the useful bibliography, covering the subject of atomic energy, for which I am most grateful.

The entire study was made possible by a generous grant to me in the form of a fellowship by the John Simon Guggenheim Memorial Foundation.

Finally, as in all things, I owe to my wife an immeasurable debt for her counsel, her confidence in me, and her companionship. This stilted, formal acknowledgment does no justice to her contribution.

It is necessary to point out that time has elapsed between the writing and the publication of this book. Although the manuscript was finished in the early part of 1947, factors over which the publishers assure me they had no control were responsible for the postponement of publication. It was essential on two occasions at least to go over the manuscript in its entirety, to make minor revisions, and to add footnotes so as to incorporate changes and new developments that have taken place in the area of domestic control during the past year. Only one major policy formulation, the decision by the Atomic Energy Commission not to conduct research in its own laboratories, departs sharply from the interpretations of the Act set forth in these pages. Brief comments on the meaning and consequences of this questionable decision have been appended to the text. Unfortunately a careful analysis of its implications would, even if all the facts were available to us—which is certainly not the case—carry us too far afield.

As for the rest, the materials freshly added bring the text up to date to the best of our knowledge and means.

James R. Newman

Contents

1. Introduction

The sun is lost, and the earth, and no man's wit
Can well direct him where to look for it.
And freely men confess that this world's spent,
When in the Planets, and the Firmament
They seek so many new; then see that this
Is crumbled out again to his Atomies.
'Tis all in pieces, all coherence gone;
All just supply, and all Relation. . . .

John Donne, *An Anatomy of the World: The First Anniversary.*

There are certain periods appointed for the world, which while they endure, all things do come to their vigour; and which being ended they do all perish . . . when the one cometh to end, and the other is ready to begin, there are many strange signs seen both in earth and in heaven. Wherefore many are of opinion that some great alteration doth approach, considering the signs which within these few years have appeared. . . .

Louis le Roy (translated by Robert Ashley), *Of the Interchangeable Course or Variety of Things in the Whole World,* 1594.

The Setting

In constructing the atomic bomb the organized intelligence of man mastered a complex of scientific, engineering, and production problems more massive and intricate than any that had been overcome. Completion of this task directly created a complex of political, social, and economic problems beside which the technological difficulties already mastered appear attractively simple.

Man has at last produced an instrument powerful enough to destroy society. Ever since that fateful August 6, 1945, when the beginning of a new historical era was signaled by the flash over Hiroshima, we have been attempting to comprehend this fact and

to understand its implications. The endeavor has filled even the most optimistic among us with a sense of frustration and dread. Our behavior under these circumstances has followed the normal psychological pattern: we have sought escape. Most laymen have simply attempted to put the matter out of their minds—to what effect we may judge from the mass hysteria that swept France on the occasion of the hoax broadcast that announced the destruction of the world by atomic disintegration. Some scientists have shown a wistful desire to undo their dreadful handiwork and to reestablish things as they were before their impious curiosity led them to tamper too far with the powers that hold man's world in tenuous cohesion. For example, Dr. Harold Urey, Nobel prize winner in chemistry, whose discoveries were of pioneering significance in the ultimate unleashing of the atom, suggested in testifying before the Senate Special Committee on Atomic Energy that Congress might well consider destroying all existing fissionable material, perhaps by dumping it into the ocean, and prohibiting further manufacture. There would undoubtedly be wide support among scientists for such a program if there seemed to be a reasonable chance that it would work.

Unfortunately, this policy is no more realistic than the layman's solution of just forgetting about the whole thing. As Dr. Urey himself implied in other portions of his testimony, and as scientists have unanimously agreed, the decision in this matter is not in our hands. The basic knowledge necessary for the construction of the atomic bomb is so widely diffused that we must assume that any technologically advanced nation will be able to duplicate our success within a few years, regardless of how zealously we protect the "secret." We can no more undo what has already been done than we can reverse the course of the earth about the sun.

Since we have no power to thrust back into its bottle the jinni so rashly uncorked, we have no choice but to attempt to control it. To be effective, this attempt must enlist the efforts of all men—or at least of men in all technologically advanced states. In this problem, in the long run there can be no partial success. If we are candid,

we must conclude that, unless we succeed completely, we will in the end be overwhelmed in utter failure.

The dilemma is easy to state, but it suggests no ready solution. The difficulty is, of course, that there can be no solution within the present framework of national institutions. And for all the blows that the sovereign nation-state has sustained in the past half century, its forms are still hard and strong. The real test will be the strength of the loyalties it commands—whether emotional attachment to a form that is no longer viable will be stronger than the logic that dictates its modification. What the peoples of the world are now being called on to do, initially through their representatives at the United Nations, is nothing less than to make the choice between life in civilized society and the sovereign state, which has long been for many a symbol more precious than life itself.

This book deals with the control of atomic energy within the United States. Until international control becomes a reality it is necessary for the United States to take such steps within its own borders as are possible. But hopeful and constructive as the Atomic Energy Act of 1946 is in its approach to the problem of controlling atomic energy in the service of man, it will in the end—like everything else in human life—be futile in the absence of an effective system of international control.

This caveat is not intended to reflect on the achievement of Congress in passing the Atomic Energy Act. This was without doubt the most significant accomplishment of a legislative session marked more by the politics of maneuver and the pork barrel than by creative statesmanship. Indeed, to many observers who followed closely the activities of the Seventy-ninth Congress, the most remarkable thing about this remarkable statute is that it was ever enacted at all.

For, make no mistake, the Atomic Energy Act is a radical piece of legislation—in some respects as radical and unprecedented as the scientific discovery that occasioned it. It is, in sober fact, an act without precedent in the legislative history of this or any other country. Never before have men in any state, standing on the threshold of a new technological era, attempted to provide in advance for rational control of the forces to be unleashed. And never

before in the peacetime history of the United States has Congress established an administrative agency vested with such sweeping authority and entrusted with such portentous responsibilities as those conferred on the Atomic Energy Commission. The Act creates a government monopoly of the sources of atomic energy and buttresses this position with a variety of broad governmental powers and prohibitions on private activity. The field of atomic energy is made an island of socialism in the midst of a free enterprise economy.

Yet aside from a short and heated fray over the patents section, it appeared to be almost universally agreed that no measures less comprehensive would serve the nation. The explanation of this phenomenal unanimity is not far to seek. At all the meetings of the Senate Special Committee that drafted the bill could be sensed a presence—unseen but tangible. This was fear for the national security. Although there were other considerations that had their effect in shaping the provisions of the Act, certainly this one was more weighty than all others, and but for it they would have assumed an altogether different form. Again and again during the course of the legislative drafting, the requirements of security came into head-on conflict with traditional elements in our system, and always in the end security prevailed. The Senate Special Committee candidly faced the fact that atomic energy could not be contained within the framework of existing institutions and drew the inescapable conclusions. Under the compulsion of security considerations, it drafted a measure that radically limited the traditional rights of private property in our system.

To one who likes his history seasoned with paradox, the spectacle of a predominantly conservative Congress under the goad of the powerful conservative instinct of security enacting a thoroughly radical piece of legislation must provide considerable satisfaction. Political forms have, of course, always been remarkably malleable under the powerful pressure exerted by the urge for security. In the sixteenth and seventeenth centuries this force was perhaps the most important single factor in producing the nation-state whose centralizing monarch ended the internecine warrings of petty princes

and brought peace and order to large areas. Security once established, the powers of the central government were in the eighteenth and nineteenth centuries sufficiently relaxed to permit the growth of a new set of satrapies—the great corporate concentrations and organizations representing the dominant economic interests of the community. In the United States the power of these groups had grown without effective check until the radical insecurity of the great depression brought forth the New Deal and its powerful central controls. These controls were strengthened as a result of international uncertainty and even further by the demands of total war. But to meet war demands quickly and in the quantities required for total conflict, the government itself was obliged to turn to these groups. War contracts accelerated economic concentration and fortified the financial position of the largest business interests. Thus strengthened, as the end of the war approached, these forces prepared to reassert their powers in the state and planned an uncompromising battle for the scrapping of state controls. The series of victories they won seemed capped by the final triumph of the Congressional elections in November, 1946. But, like a skeleton at the feast, the Atomic Energy Act had appeared to remind them, if they chose to consider its implications, that in the atomic age such triumphs are illusion and so long as international anarchy exists, whatever powers the state surrenders, it will sooner or later recapture in the name of security.

The framers of the Act faced problems candidly, and they did not flinch from the implications of what they saw. The provisions they incorporated in the Act were as specific as they could be made on the basis of available knowledge, and their terms carried as far as the vision of the wisest was able to penetrate. The limitations and the shortcomings of the Act, within the terms of reference we have described, are in fact the limits and shortcomings of human vision.

It must be confessed that the prognosticating powers of the best-informed nuclear scientists and the most perceptive social scientists with respect to future developments in the science of nuclear physics and the social, political, and economic effects of such developments

are not impressive. The members of the Senate Special Committee had little but generalities to help them in drafting legislation to meet a new technological era and possible revolutionary changes in social institutions. An analysis of the testimony offered reveals little more about the nature of impending changes than the conviction that they will come and that they will be important.

The scientists were certain that by the use of fissionable materials and radioactive materials profoundly significant further discoveries in basic science would be made, which in time would produce innumerable and unpredictable technological devices and apparatus. In the immediate future, however, all they could be sure of were some limited medical applications of radioactive materials, and the utilization of atomic energy for the generation of power. It is a little disillusioning to discover, for all our progress in mastering natural phenomena, how little ability we have to predict the chain of events that an epic discovery will set in motion. The savants who so startlingly demonstrated their insight into the heart of the atom manifest only the most imperfect intuitions of the scope of the application of the power they have won and no confidence at all in their ability to predict the social, economic, and political consequences of their discovery; historians find no precedent to give us guidance, and even the indefatigable categorists in the science of sociology exhibit an unwonted reticence.

The Act ultimately passed by Congress and signed by the President almost exactly one year after the dropping of the bomb on Hiroshima raises a number of substantive issues of fundamental importance, and settles none of them finally. The Act is, in fact, a beginning, and the most that can be said for it is that it provides a favorable context for the solution of most of these issues.

Each of them is discussed in detail in the chapters that follow. Here we propose to review briefly the three principal questions before Congress:

1. Should government control of atomic energy be exercised by military or civilian officials?
2. To what extent should scientific activities be controlled?

3. How should private commercial activities in this field be controlled?

Considering the scope and number of the issues presented by domestic atomic energy legislation, it is remarkable how few of them were thoroughly debated either in Committee hearings or on the floor. One violent and dramatic debate there was, which became for a space of several months the stuff of headlines.

The great debate, of course, was over the issue of civilian vs. military control of the Commission. Indirectly, it involved the further issues of freedom vs. authority, of nationalism vs. internationalism; but even conceding that the debate on the civilian-military issue fully illuminated these incidental problems (which in fact it did not), there were other questions of importance scarcely touched upon at all. And of the basic question—the effect on our predominantly free enterprise system of an island of socialism—there was no discussion at all. Once the military-civilian control issue was resolved by the critical compromise of the Act, most of the other provisions followed with little controversy.

Civilian vs. Military Control

In March, 1945, two months before the atomic bomb was first tested in New Mexico, Henry L. Stimson, then Secretary of War, appointed with the approval of the President an interim committee to recommend legislation for the domestic control and development of atomic energy. Secretary Stimson was the chairman of this committee, and the all-civilian membership included a number of prominent government officials and persons of distinction in the academic and business life of the country.*

The recommendations of this committee, made during a two-month study of the problem, were incorporated in an atomic energy

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bill then under preparation in the War Department. Upon approval by the committee this bill was introduced in the Senate by Edwin C. Johnson of Colorado and in the House of Representatives by Andrew J. May, Chairman of the House Military Affairs Committee. Thus was conceived and introduced to the country the famous May-Johnson bill, which became identified in the public mind with the military control of atomic energy.

Since this bill incorporated provisions that produced a struggle of epic proportions, evoked a flood tide of debate, dramatized the problem, and accomplished whatever degree of public education there has been on the problem of the domestic control of atomic energy, it is worth while summarizing some of its provisions here.

The bill provided for the establishment of a commission for the domestic control and development of atomic energy and conferred upon this commission broad powers to engage in research and production, to make arrangements of unlimited scope with private institutions and persons for the exploitation of the field, and to make and enforce security and safety regulations. Many of these powers —and a few more—were ultimately incorporated in the McMahon-Douglas bill, but the May-Johnson bill provided for a *part-time* commission and it explicitly provided that commission members might be officers of the Army or Navy.

This last provision touched off the climactic battle. No doubt the air was surcharged, and there was a certain ominousness in the highhanded manner in which the Chairman of the House Military Affairs Committee seemed to be engaged in railroading the measure through. (Hearings were originally limited to one session during which the only witnesses heard were Secretary of War Patterson, Dr. Vannevar Bush, Dr. James B. Conant and Maj. Gen. Leslie R. Groves.) But there was little warning of the storm that broke almost immediately. The bitterness of the struggle and the zeal of the participants can be taken as indicating the depths to which men had been stirred by the formidable power of atomic energy and also the general conviction that what was being decided in the halls of Congress was no simple issue of domestic politics but the whole

nature of our political institutions and perhaps the future of the world.

The historian who attempts to recreate this drama is appalled by the confused and chaotic nature of the action. The scene that confronts him resembles the description of the Battle of Borodino in Tolstoy's *War and Peace*. The hosts gather, impelled by some impulse deeper than they comprehend, seeking a goal they do not altogether understand. The struggle that ensues takes on a life of its own, independent of any individual's will or direction. The conflict swirls and eddies and becomes not one but scores of battles, each appearing crucial to its participants. The field is a confused jumble of motion, the whole is obscured in smoke, and even the commanding generals have little understanding of developments, much less any effective control over them. The motives of the contestants are frequently obscure; the action is extended over weeks or months, rather than hours; there are sometimes not two but several armies engaged; alliances are shifted in the heat of battle; and in the end the issue is not decided on the field at all but in some clandestine meeting among rival leaders.

In the struggle over military representation on the Atomic Energy Commission, the contestants all claimed to seek the same objects—civilian control of atomic energy and the national security. The partisans of the May-Johnson philosophy, however, charged that their opponents were radicals who, either because of irresponsibility or subversion, were willing to jeopardize the welfare of the country. They, in their turn, were accused of seeking to establish a system that would be authoritarian, repressive, militaristic, and xenophobic. These were the symbols about which the battle was fought—little wonder that it was fierce.

The alignment of forces lacked crispness of definition, and no doubt the differences between the two sides were considerably less than the extremists of either persuasion were prepared to admit, but it appears clear in retrospect that there was a fundamental difference of emphasis and intent. On the side of the May-Johnson bill were those who were skeptical of internationalism, willing that the services should continue in the dominant position they had occu-

pied during the war, distrustful of generalities such as "scientific freedom," and sympathetic with the principle of authority. Those in opposition believed with varying intensities of conviction in the cause of international understanding, in the principle of freedom, in the relegation of the military services to a subsidiary position in our society. These differences, it seems fair to say, signified a divergency of fundamental importance in the manner in which Americans face the postwar world.

The first to sound the alarm were the scientists, who as a result of their experiences on the Manhattan District Project had had their skins worn thin and their nerve ends exposed. Sensitive as one of their own Geiger counters, they had registered an immediate and powerful reaction to the May-Johnson bill, which threatened to make permanent military control of atomic energy, and shortly after its introduction the vanguard of the army they mobilized appeared in Washington and began to draw plans for the fray.

This was a unique manifestation in the history of science in the United States. The traditional position of American scientists could be adequately summarized in Hooke's famous, if overcautious, recipe for the Royal Society—to improve the knowledge of natural things and all useful arts, but not to "meddle with divinity, metaphysics, moralls, politicks, grammar, rettorick or logick." But now in large numbers they swarmed down from their ivory towers, and with energy, fervor, passionate conviction, and a somewhat unexpected talent for organization threw themselves into the battle. It may be that they were grossly naïve in politics, but there is no denying that they showed a capacity for improvisation and prompt action beyond anything the economic groups whose interests were vitally involved in the legislation were able to muster.

Nor should their importance in affecting the outcome of the struggle be underestimated. They were at the time riding the crest of a wave of popular esteem; even the shadow cast by the massive figure of General Groves could not conceal the fact that the construction of the bomb was at least as much a triumph of scientists as it was of army officers and engineers. In the public mind they held a position of fresh admiration, and they threw the full weight of

their advocacy on the side of complete civilian control of atomic energy.

Their experiences under the Manhattan District had not been happy. The necessities of security, as interpreted by General Groves's staff, had allocated the scientists who worked on the project to rigid compartments, had forbidden communication among the occupants of the various compartments, had invaded their privacy, and had poisoned their lives. Their general position on the issue of military control is summarized in the following passage taken from an editorial entitled "Military or Civilian Control of Atomic Energy," published by one of the leading groups, the Atomic Scientists of Chicago:

> Permanent military control of atomic energy in America will signify to the world that America is basing its long-range policies on the assumption that a new war is inevitable, and this will help to make it inevitable. . . . Military control will not assure our continued advantage over the rest of the world in atomic armament and in scientific war potential in general. The Army will inevitably put emphasis not on creative research, but on building the largest number of atomic bombs of the existing type and protecting the secrecy of present processes by strict security regulations, and other police methods. The really good scientists feel that their effort will be wasted if they are forced to work under the conditions of secrecy and compartmentalization, without the benefit of free exchange of ideas. . . .

The scientists were the first to enter the field and they remained throughout in the forefront of the battle. They formed their own local groups throughout the country; they helped in the formation of citizens' committees; they furnished data to congressmen, publicists, and commentators. It was not long before they were joined by a large and variegated army, which it would have been difficult to unite in any other cause. In the ranks could be found representatives of every shade of political opinion, from radicals whose position might be taken for granted to true conservatives who rallied to the defense of the traditional Constitutional principle of civilian supremacy. Newspapers of every gradation of political opinion condemned the military features of the May-Johnson bill. Professional

societies, women's clubs, church federations, labor unions, veterans' groups, and university students adopted resolutions denouncing the provision. Letters and telegrams of protest poured into the White House and offices of the congressmen; the Senate Special Committee alone received over 75,000 messages, of which the overwhelming majority opposed the part-time military membership provision.

This storm aided the administration, by this time committed to the principle of an exclusively civilian commission, in its effort to keep the May-Johnson bill bottled up in the House. Thus the issue was brought to a focus in the Senate Special Committee, where the form of the compromise ultimately incorporated in the Act was hammered out. After the conclusion of its open hearings, the Senate Special Committee, in executive session, considered a series of proposals and counterproposals. In these deliberations, Senator Vandenberg assumed the leadership.

Although firmly supporting the principle of civilian control, Senator Vandenberg considered that the McMahon-Douglas bill in its then current form did not make sufficient provision for keeping the service departments fully informed of developments in the field of atomic energy and for assuring adequate development of the military aspects of atomic energy.

The solution he proposed was to provide in the McMahon-Douglas bill for the establishment of a Military Liaison Committee, to be composed of representatives of the War and Navy Departments, which would serve as an integrating element between the Atomic Energy Commission and the service departments. As this compromise proposal was originally drafted, however—and adopted by a 10-1 vote by the Committee—the provision gave to the Military Liaison Committee such broad powers that it was instantly proclaimed by the opponents of military control as more objectionable even than the May-Johnson bill. If there had previously been a storm blowing through the country over this issue, it now became a typhoon. Congressional and presidential mail became a deluge, mass meetings assembled in indignant protest, solemn prayers were offered. After appraising this reaction briefly, the Special Committee was moved to reconsider.

It cannot be pretended that the revised provision that became law presents a definitive and satisfactory solution to the problem of civilian vs. military control of atomic energy. It was a compromise the meaning of which remains to be demonstrated. However, the provision as adopted represented a substantial modification of the strong military bias of both the May-Johnson bill and the first version of the Vandenberg amendment. The operations of the Military Liaison Committee are confined to the area of "military applications," which though a wide enough area is not illimitable. The Commission has not only the responsibility of keeping the service departments informed of its atomic energy activities but has the right to be kept informed of the activities of the War and Navy Departments in this field.

The effort to reduce military power over atomic energy is, of course, merely a part of the larger effort to reduce the military importance of atomic energy—an end that can only be achieved by the creation of a stable and peaceful world order and a progressive nation. This provision of the Act assures that the chances of achieving these objectives will not be hopelessly prejudiced, as many feared they would have been under the provisions of the May-Johnson bill. The ultimate effect of the compromise that the provision embodies must wait upon the outcome of the larger issue.

The "Secrets" and Control of Scientific Activities

Closely related to the issue of civilian vs. military control is the problem of the control of information. As already indicated, in the minds of the scientists who had worked on the Manhattan District Project military control meant excessive concern with the problems of security, rigid compartmentalization, and a blight upon scientific progress. Their concern, it is fair to say, was primarily with the effects of a military regime on the progress of science and the life of scientists rather than with the broader political issue of the appropriate functions of the military departments in a democratic state. Perhaps the focal point of their resistance to military control was the effect of the military concept of security upon inter-

course among scientists and the free exchange of scientific information.

The May-Johnson bill was not designed to quiet these fears. It proposed to give the Commission power to issue "security regulations" specifying the information to be restricted and the persons to whom it might be communicated—a complete censorship control. The administrator was empowered to order the discharge from any organization engaged in atomic energy work, whether public or private, of any person found guilty of violating a regulation. No judge or jury finding was necessary and no provision was made for review of the administrator's action. Scientists who had found it necessary to violate regulations of the Manhattan District in order to build the bomb were not inclined to have faith in such provisions.

The provisions relating to control of information in the Atomic Energy Act are also a result of compromise. The Senate Special Committee listened with some concern to the testimony of several eminent scientists to the effect that the security policies imposed by the War Department materially hampered their work and slowed progress in the development of the bomb, and attempted to go as far in meeting these objections as they felt the paramount requirements of security justified. The provisions they framed were, however, made more stringent in the course of deliberations in the House. The result was to produce a section that, although acknowledging the importance of free exchange of information to scientific progress, imposes severe and sweeping prohibitions on scientific intercourse.

The information section of the Act reveals the atavistic depths that have been stirred by the release of atomic energy. The response to this greatest of all triumphs of scientific method and creative intelligence has been in some respects closely akin to the practice of magic among the most primitive of tribes. Having in their possession a fearful image of the god of war, which makes them stronger than all their enemies, the tribe is obsessed with the fear that the image may be stolen or duplicated and their exclusive claim to the deity's favor lost. So a temple is built, ringed about by walls, and guarded by untiring sentinels. Those whose function it is to attend the deity are carefully chosen and subjected to purification

rites; they are forbidden ever to look upon the whole image or to speak of what they have seen. They are guarded with unceasing vigilance, and at the slightest sign of defection condign punishment is visited upon them.

Section 10 begins with the statement of the policy "to control the dissemination of restricted data in such a manner as to assure the common defense and security." "Restricted data," as the Act defines the term, goes far beyond the classification of atomic weapons and includes data "relating to the production of fissionable material, or the use of fissionable material in the production of power." These categories cover a very large area of nuclear science and embrace much that is of general importance to fundamental as well as to applied research. It does not matter whether these data are discovered or compiled in a government laboratory or in connection with the private research of an individual scientist; the interdict covers them in either case. Aside from the recent Nazi-Fascist aberration, therefore, we see for the first time in centuries a state that shares in the tradition of western civilization, attempting to enforce prohibitions upon the communication and discussion of scientific discoveries relating to the laws of the universe.

It appears that this is not only revolutionary but also, judged pragmatically, very dubious doctrine. The preponderant opinion of scientists who testified before the Senate Special Committee on Atomic Energy was that these measures would be futile (since, in fact, we possess no "secret" that cannot be divined within a relatively brief period by the organized scientific intelligence of any technologically advanced nation) and positively harmful (since the restrictions on the free exchange of ideas among scientists will serve to retard the rate of scientific development). This opinion can be summed up in an aphorism of C. F. Kettering: "When you lock the laboratory door, you lock out more than you lock in."

Unless this system of rigid taboos and heavy penalties is administered with much intelligence and restraint and the apprehensions of nuclear scientists are allayed, it is entirely possible that it may result in a heavy setback to the development of atomic energy in the United States. This is a serious enough matter, considering what

it may mean to our national security, but possibly even more serious is the Constitutional issue of restraints upon free intercourse among scientists that is raised.

Implicit in this provision is the proposition that, in a world ruled by fear of the atomic bomb, the state is justified in carrying over into times of nominal peace the restraints upon the freedom of the individual it imposed in war. Whereas the Espionage Act, the only law that sought to control communication in the interests of national security prior to the enactment of the Atomic Energy Act, had been confined to official secrets and its more stringent penalties limited to the actual duration of hostilities, Section 10 of the Atomic Energy Act has no such limitation of time and subject matter.

To validate Section 10 it is necessary to hold that the dangers to national existence resulting from communication of the type prohibited are so great as to justify the limitation on freedom of speech and freedom of the press which are involved. In the event that the climate of international relations improves and effective progress is made in plans for the international control of atomic energy, this provision will become quickly outdated and signify little. If these favorable developments do not occur, however, it would be unrealistic not to regard Section 10 as in itself a danger to the principle of individual freedom and a warning precursor of a host of restrictive enactments to come.

The provisions of the Act relating to information are largely restrictive and, it is feared by many scientists, likely to be repressive to scientific development. The research provisions, on the other hand, are positive and place the Atomic Energy Commission in the role of stimulator, promoter, and coordinator of scientific research in atomic energy and all its applications.

The Atomic Energy Act, in fact, embodies most of the basic principles which made the Kilgore bill for the establishment of a National Science Foundation the target for such heavy attack during the tenure of the Seventy-ninth Congress.* But while the Kilgore

* In the closing days of its first session the Eightieth Congress passed the Smith bill establishing a National Science Foundation. The bill, providing for an agency controlled by twenty-four part-time directors, sought to create what

bill had in its favor only the fact that it was designed to promote the public welfare and proved vulnerable to covert attacks from industry and representatives of organized research, the Atomic Energy Act involved the national security and was therefore more difficult to combat.

Like the Kilgore bill, the research section of the Act has as its basic principle the proposition that the self-regulating mechanism of the market place cannot always be depended upon to produce adequate results in scientific research. From this principle it proceeds to the conclusion that, where there is a failure on the part of private research, this failure must be made good on the initiative of the state.

To speak of the making good of failures in research implies, of course, the existence of some over-all concept of what research should do, and this is merely another way of saying there must be a plan. The Act clearly intends that the Commission should plan research in order to serve the broad objective of promoting the development of atomic energy in the interest of public welfare, increasing the standard of living, and strengthening free competition in private enterprise.

To accomplish these purposes, the Commission is not given an elaborate coercive mechanism such as it had conferred upon it in connection with its responsibilities in controlling information. It has precisely the same power to achieve its objectives that private industry has—staff and the power to spend money. But whereas private industry is justified in spending money on research only when projects offer reasonable prospect of showing a profit, the Commission has the infinitely broader mandate of supporting projects that will further scientific knowledge or ultimately contribute to the public welfare or improve the standard of living.

So intent were the framers of the Act in doing nothing that might hamper or restrict the conduct of research by private institutions

was commonly regarded as an administrative monstrosity. Moreover, the Foundation was restricted to the support of research in the physical sciences, biology, and medicine, the social sciences being excluded. There was no provision for reforming the higgledy-piggledy patent practices of the Federal government recently exposed in a monumental report by the Attorney General. For these and other reasons the bill was vetoed by the President.

or persons that they excepted research activities from almost all the prohibitions and restrictions of the Act. Thus, research is exempted from the general prohibition on the private ownership of facilities for the production of fissionable material and the utilization of fissionable material without a license.

In fulfilling its responsibilities under this section, the Atomic Energy Commission must survey its field—and probably cognate fields as well—evaluate the work being done under private auspices, fix its objectives in terms of a calendar of development, measure progress, and determine what requires to be done that is not being done. In order to meet its objectives it can make grants or undertake contracts and, if it sees fit, it may undertake work itself.

In effect, this will mean that the state will play an important role in scientific research, a field hitherto dominated by industry, with some assistance from universities and research foundations. To the universities this intervention should be an aid and a stimulus, making possible more work on basic science and assisting in those fundamental research programs that are not attractive to private funds because they do not promise immediate profits. To the individual scientist, it will certainly mean no limitations on his freedom but rather a broadening of the avenues of opportunity open to him and a better chance to follow research activities he prefers. To industry, it is true, this intervention may initially serve as unwelcome competition for the limited amount of skilled research talent available, but in the long run the effect of the Commission's programs, if the past history of science can serve as a guide, should serve to open up great opportunities for private enterprise that might never have been discovered if left to private capital.

We have had during the war a demonstration of the miracles of which science is capable when fully mobilized and directed with single-minded purpose to the production of weapons. Now for the first time in our history we are making an experiment to determine what science can do when organized and effectively geared to a constructive peacetime objective. In this great effort the energy and the bulk of the initiative will have to come from private individuals and private institutions; the state will assess, coordinate, and or

occasion serve as a compensating element, undertaking to stimulate development in those areas where it considers that private efforts are inadequate. The future of this experiment, assuming it is not engulfed in an armaments race, will be significant for an area wider even than atomic energy.*

The Socialist Island

Both the McMahon-Douglas bill and the May-Johnson bill proposed to give the Commission a broad range of powers in controlling atomic energy, the principal difference being that the controls were made specific and predetermined in the former while they would have been wholly up to the Commission in the latter. Nevertheless, on this basic substantive issue there was surprisingly little controversy. On the side habitually defended by exponents of the doctrine of private property and free enterprise there were few voices raised.

And yet the Act cuts more deeply into the area traditionally reserved to private business in our system than any ever passed in time of peace. In fact, it does nothing less than establish in the midst of our privately controlled economy a socialist island with undefined and possibly expanding frontiers. Into a system that was happily being reclaimed for free enterprise in the postwar period the Act deposited a large, portentous, alien, and unassimilable lump. What the outgrowth of interaction between these opposing elements is likely to be Congress did not even discuss. The interaction may generate powerful forces and no ultimate equilibrium is now discernible. It may well be that the existing form of our economic order is no better able to contain atomic energy than is the present international order and that, in fact, the force will produce political changes in the internal arrangements of our society as momentous as

* The Second Semiannual Report of the United States Atomic Energy Commission seems to indicate that the Commission has entered this phase of its responsibilities with some vigor and offers the encouraging prospect that it will both plan and support pure research and the development of at least the medical applications of atomic energy. The report makes clear nevertheless that the overwhelming bulk of the Commission's efforts is now being devoted to the production and improvement of atomic weapons.

those that will almost certainly occur in our external relations. This was certainly not settled by the Act: in fact, though there was an uneasy recognition of its existence, the problem—perhaps for the escapist reasons already mentioned—was never thoroughly debated. We have already indicated some of the elements that explain how such an Act could have been passed at a time when the prevailing temper of Congress and of the country at large was one of extreme impatience with the whole complex of wartime controls of business activity. The basic element was, of course, concern for the national security. Another was the effect of this stupendous power on the public imagination and the general acknowledgment that a force of such unprecedented nature required unprecedented measures to cope with it. Perhaps a third was the inability of business interests to assess quickly the significance to them of measures dealing with atomic energy and to mobilize rapidly behind a defensible position.

Consequently, it was only in connection with the patent provisions, which appeared to strike at one of the principal citadels of private enterprise as it is at present organized in the United States, that any significant opposition was manifested. The patent provisions were, however, for the most part necessary corollaries of the general control provisions, and if it was assumed, even by the implicit consent of silence, that the control system as a whole was necessary, it was difficult to make a convincing case against the patent provisions in isolation.

What, exactly, is the scope of the powers of the Atomic Energy Commission that results in the Atomic Energy Act being described as a legislative enactment without precedent in the peacetime history of the United States? For the purposes of exposition, it will be convenient to think of the control system of the Act as represented by three concentric circles. The innermost circle, fairly definitely formed, is the area of government monopoly; the intermediate circle is the area of direct government controls by means of licensing, the granting of fissionable materials, etc.—an area potentially very great, with elastic boundaries—and the outermost circle comprises the area of indirect controls, including parts of the economy not themselves within the field of atomic energy but likely to be affected

by the operations of the Commission in connection with the exercise of its monopoly activities or its control functions.

The area of monopoly includes the facilities for producing fissionable material—a 3.5-billion-dollar empire that is certain to expand. It has properties in twenty states. Its operations employ thousands of people. The Commission has exclusive ownership of all fissionable material; an entirely new legal substance is created, one that cannot become an object of private ownership. This substance may in time become more important than coal and petroleum combined. Although the point is not certain, the area of monopoly may include all atomic power projects—potentially of a vastness that will make TVA appear minuscule.

Beyond the central area of monopoly extends the intermediate circle of control. The Commission by its licensing power can regulate every single transaction involving source material, every industrial and commercial application of atomic energy. It can eliminate patent rights where it deems they interfere with effectuation of the purposes of the Act.

Beyond the area of atomic energy proper, its controls cut across a considerable segment of the total economy. It can at its discretion extend licensing control to any substance deemed essential to the production of fissionable material and abrogate patent rights, regardless of their apparent remoteness from the field of atomic energy, if these rights interfere with the utilization of fissionable material or atomic energy.

The policies followed by the Commission in exercising these powers must have a direct and powerful impact on many important aspects of our national life. They will affect not only our military security but our foreign policy, the value of existing capital investments, the structure of industry, and the level of prices and employment—in the end, the structure of society itself.

The powers were conferred by Congress only with profound misgiving and after prolonged heart searching. The Act was passed in the midst of an overpowering nostalgia to return to things as they were, before the disturbances of war and the rude innovations of the New Deal. In passing it Congress implicitly recognized that

under the disintegrating force of the atomic bomb the ancient institutional forms, honored and familiar though they were, had become obsolescent. For it is apparent that in the atomic age, in times of international unbalance, there is no limit to what the state will have to do in the name of security. There is disagreement among scientists as to just when the world will be technologically prepared for the war of push buttons that will make possible the instantaneous destruction of dozens of cities and millions of people; but apparently the only question is how long it will be before this scientific triumph becomes possible. The tacit recognition of this fact underlies the whole Act and was so generally understood that there was never even a discussion of the Constitutional power under which this great program was to be carried forward. It was taken for granted that the Atomic Energy Act would be validated under the same complex of Constitutional powers that had enabled the government to conduct the gigantic war just completed—the power to raise and support an army and navy, to declare war, and to undertake such functions as are necessary and proper to the effectuation of these purposes. With a few minor exceptions—such as the construction of the dams ultimately included in the TVA project—these powers in the past have been invoked only in actual time of war or after the declaration of a national emergency. The Atomic Energy Act was passed, however, when the country was at peace a few months after a great war had been victoriously ended and when there was no specific danger on the international horizon.

This is ominous doctrine, although there can be little doubt of its acceptance by the courts. What it means is that in the new age just beginning the war powers of the Constitution will be as illimitable in time of peace as they are in time of war. We have already commented on the implications of this doctrine as it affects limitations on the government in the interest of safeguarding individual freedom. The comments can be extended. There is no escaping the logic of the conclusion that, given the terrible possibilities of total national destruction, no definable bounds can be set to the war powers even in times of nominal peace and the Constitutional doc-

trine of limited government and specifically delegated powers must become outmoded.

We have not yet faced the fact altogether clearly, but the choice that lies before us is between a genuinely working international order and the total military state kept always in a condition of total preparedness. When Congress voted the Atomic Energy Act, in effect it announced the end of the institution of the sovereign national state based on the system of capitalistic free enterprise. If we are to keep a system of capitalistic free enterprise, we must have conditions of genuine peace and security, which permit men to go about the business of concentrating on a profit without fear of instant death; and it is apparent that this end can be achieved only by the surrender by the state of certain powers hitherto deemed indispensable adjuncts of sovereignty. If, on the other hand, we are determined to keep the sovereign nation-state, we will have to surrender to the state personal and economic freedoms we have traditionally enjoyed; we will have to renounce a largely uncontrolled and self-regulating economic system; we will have to gear the whole of our social institutions to the end of national security, establishing the great bureaucracy and the bewildering complex of governmental controls that experience has shown to be necessary for this purpose. There will have to be other laws to follow the Atomic Energy Act—an act establishing a great program of stand-by plants ready to convert instantaneously to war production; an act providing for a huge permanent military establishment, fully armed and continually alerted; and, as conditions deteriorate, an act undertaking deconcentration of our industrial plant and our huge urban centers. The demands of security will be implacable and illimitable.

The issue remains open and at present the country wavers between the poles of international security and the military state. It is entirely possible that it will be several years before the outcome is determined.

In the meantime, the Commission undoubtedly feels the effect of the opposing tendencies. It has this enormous complex of power to exercise; it has to operate in a situation tense, confused, and ill-

defined; it is administering an institution conceived on lines currently repugnant to a large part of the population of the country; and to guide it, it has only the most general of policy statements:

> It is hereby declared to be the policy of the people of the United States that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.

The practical application of these standards is a test of wisdom and statesmanship such as no other administrative agency has ever been called upon to meet. The field in which the Commission operates is well populated with sensitive and highly vocal private interests; its actions will affect property rights and expectations of profit. There is no steady magnetic pull pointing policy unerringly to the lodestar of the national interest, and disturbances in the magnetic field caused by the filings of private interests will be acute and constant. Under these circumstances, the role of the Commission can be no more firmly fixed than that of the Supreme Court when it began the task of interpreting the Constitution.

The framework for its operations is spacious and, to a considerable degree, plastic. The objectives of policy given it for guidance are inclusive enough to justify almost any course the Commission sees fit to steer. It is true that the factors that must ultimately determine its orientation lie largely outside its control—in the arena of international politics and in the mysterious interstices of the public mind. Nonetheless, its powers for good or for ill are enormous. It has been granted unprecedented authority to perform a task of historic importance, and its responsibilities are as grave as its opportunities are great. Whether the world will choose the incalculably difficult path to an effective international order or in frustration and despair sink into the slough of warlike preparations in which no civilized life is possible is, of course, an issue upon which the Commission can have little direct effect. But it can stead-

fastly resist any drift toward despair or any sudden wave of hysteria; it can demonstrate the public benefits that can be made to flow from purposive public planning of a great national resource; and it can show that such planning need not be incompatible with the preservation of individual liberties. It can, by the exercise of its unprecedented powers, accelerate the development of peacetime applications of atomic energy and thus afford practical evidence of the enormous constructive potentialities of this newly won force when devoted to the service of man.

2. Organization and Structure of the Commission

Government is not a machine, but a living thing. It falls, not under the theory of the universe, but under the organic life. It is accountable to Darwin, not to Newton.

Woodrow Wilson, *Constitutional Government in the United States,* Chapter 3.

And let me say that large powers and unhampered discretion seem to me the indispensable conditions of responsibility. Public attention must be easily directed, in each case of good or bad administration, to just the man deserving of praise or blame. There is no danger in power if only it be not irresponsible. . . . If to keep his office a man must achieve open and honest success, and if at the same time he feels himself entrusted with large freedom of discretion, the greater his power the less likely is he to abuse it, the more is he nerved and sobered and elevated by it.

Woodrow Wilson, *Political Science Quarterly,* June, 1887.

The Commission

The Atomic Energy Commission is composed of five members, appointed by the President and confirmed by the Senate. The Commissioners are civilians serving full time and may not engage in "any other business, vocation, or employment. . . ."

Congress added the somewhat unusual stipulation that in submitting nominations to the Senate the President shall set forth the experience and qualifications of each nominee. This provision was clearly intended to emphasize the importance that Congress attached to membership on the Commission and to increase the likelihood of appointments on the basis of qualification alone. The objective is laudable but the device somewhat naïve. The provision can

scarcely be deemed an effective legal restriction on the President's free choice of Commissioners; indeed, it would be unfortunate if it were so interpreted. Furthermore, the term "qualification" is so vague that the Senate could hardly reject a presidential nominee on the grounds that he was not "qualified." At most, the provision gives the Senate scope to rationalize its disapproval of an appointee because of his social or economic philosophy.*

The five Commissioners, one designated as Chairman by the President, constitute the principal governing body established by the Act. The scope of the Commission's powers and duties, the dimensions of its opportunities, exceed those of any department of the government ever before established. The Commission has, in effect, a plenary charter to do anything in the field of atomic energy that will promote the public safety and welfare. It is responsible for the control and development of all domestic phases of atomic energy; for carrying out federal production, research, and development programs; for issuing licenses relating to source material and utilization devices; for issuing and enforcing various regulations, including those pertaining to the protection of health and safety; for stimulating and supporting private research and development; for controlling the dissemination of scientific and technical developments. It was only the magnitude, the complexity, and the unprecedented nature of the problems raised by the successful release of nuclear energy that could have moved Congress, always jealous of its own authority, to delegate such sweeping powers to an administrative agency.

* The hearings on the fitness of the President's first appointees to the Atomic Energy Commission bore little relation to the letter or spirit of the Act. David Lilienthal, named as Chairman, was clearly the best qualified commissioner, yet his proved talents as a technician and administrator were the subject of only brief notice. Instead, his political beliefs, his social philosophy, his economic views, his past life, even the birthplace of his parents were permitted as relevant areas of inquiry for Senator McKellar of Tennessee, who, while not a member of the committee, enjoyed a field day of character assassination in availing himself of senatorial courtesy! As for the other nominees, including the General Manager, there was no more than a perfunctory examination of their qualifications. Several Republicans, including Bricker and Taft, openly opposed Lilienthal, regardless of qualifications, on the astonishing charge that he was a New Dealer and that the Republican victory at the polls in November, 1946, constituted a repudiation of New Dealism and a mandate to Congress to "clean out the leftists."

Form of Organization

The principal issue of organizational structure that Congress had to decide was whether to entrust the broad powers it would be necessary to delegate in the Act to a single administrator or to a directing board composed of several members.

The merits of the single administrator as compared with the plural board is one of the questions most voluminously discussed in the literature of political science. Any detailed analysis of this literature would be supererogatory here, but it is useful to recall the principles that have become accepted as doctrine. The following quotations from a report by the Brookings Institution on the executive agencies of the government provide an admirable summary:

> The arguments against the board are familiar: it diffuses responsibility; it is slow to act; it may be fitted to deliberate over policies, but it is not fitted to direct operations; since it is usually dominated by one man anyway, the dead timber should be removed, and the one dominating personality should be made solely responsible; only through a single head can an agency be made responsible through the chief executive and provision be made for cabinet representation; and finally, the advantages, without the disadvantages of a board may be obtained through the setting up of an advisory council.

> It may be granted that the presumption is usually in favor of a single head; and this presumption is strong where the activities are exclusively, or almost exclusively, administrative with little work of a quasi-legislative or quasi-judicial character . . . (but) when the new function is embryonic or experimental, a board may provide some assurance that the problems arising in the administration, evaluation and development of the function will be deliberately studied from all angles. In other words, while the actual function may be largely or wholly administrative, the important need during the period of experiment and transition is for policy making, *i.e.*, quasi-legislation.*

These passages are quoted because they state propositions so universally accepted as to have become axioms of public administration. When the decision was made to entrust the powers of the Act

* Report of Brookings Institution, June 19, 1937, to Senator Harry F. Byrd, Chairman Select Committee to Investigate the Executive Agencies of the Government.

to a five-member Commission, it was not because of a rejection of the general rule that an agency headed by a single administrator is more efficient. It was rather because the exceptional circumstances listed in the paragraph above as justifying a departure from the general rule seemed to be present to an extraordinary degree in the Atomic Energy Act. Functions to be performed under the Act are "embryonic" and "experimental" to a unique degree. The scope of the policy-making functions that Congress felt impelled to transfer to an administrative agency seems startling in time of peace even after the acceleration that the past fifteen years has brought in the practice of delegation by legislation. The Act confers powers whose exercise will affect the national security, the progress of science, the value of billions of dollars of investments, and ultimately, as was said before, the whole structure of our society. The issues at stake, it was felt, were too intricate and too fateful to be left to one man's decision.

The fact that the legislative draftsmen were aware of the faults generally attributed to the multimembered board is indicated by the measures that they incorporated in the Act in an effort to mitigate these faults. Several provisions are designed to counteract the tendency of a plural-headed agency to go its separate way with only a nominal dependence on the President and something less than effective integration with administration policies: The Commission is required to receive directions from the President at least once a year setting its policies with respect to the major issue of what quantity of fissionable material is to be produced and how this quantity is to be allocated among various end uses. There is in the Act a clear recognition of the fact that a five-member Commission cannot efficiently direct operations; provision is made for a general manager who is intended to have primary responsibility for such functions, leaving the Commission free to devote itself to policy questions.

It is impossible to predict how effective these devices will actually prove in mitigating the worst faults in the Commission system. In the integration of the Commission's work with general administration policy much will depend on the skill of the President's staff.

The efficiency of the internal operations of the Commission will in large measure depend on the success of the Chairman in establishing the proper relationship with his fellow Commissioners and with the general manager, for with the former he must frame policy and with the latter he must plan for its translation into action.

If, after a period of testing, the organizational machinery of the Act is judged to be unsuited for the tasks it is called on to perform, Congress may of course decide to change it. Such action would not be without precedent.

Full Time vs. Part Time

The Act requires members of the Commission to serve full time, expressly directing that "No member of the Commission shall engage in any other business, vocation or employment than that of serving as a member of the Commission."

The overwhelming majority of the witnesses before the Senate Special Committee on Atomic Energy urged a full-time Commission. Nevertheless, the institution of a part-time Commission was not without its advocates and, indeed, provision for such a governing group was incorporated in the discredited May-Johnson bill. This fantastic proposal—that the vast, complex, and portentous responsibilities involved in the control and development of atomic energy should be entrusted to a group of part-time officials—could have sprung only from naïvete or duplicity. It was the product either of a complete lack of understanding of the Commission's task or of a disingenuous purpose to make the Commission susceptible to the influence of private interests.

Because large corporations and great universities are managed—and often well managed—by part-time directors, it was contended that the same pattern of control would serve for atomic energy. The argument does not bear analysis. The analogy is false, since the nature as well as the magnitude of the tasks is altogether different, and it conceals entirely the basic assumption on which such a part-time Commission must be founded—that it is possible to serve faithfully, and *concurrently*, both the public and one's private business. War exigencies were held to justify exception to the in-

contestable principle that no one should be permitted to retain his private business interests while acting in a position of official responsibility; experience with the dual loyalties of some of our wartime officials seems scarcely to justify this extension of the practice to times of peace.

A more plausible advocacy is based on the well-established fact that an honest civil servant cannot expect to grow rich on his government salary. Thus, the argument runs, men of eminence in business, industry, or professional life can hardly be expected to exchange their high incomes for the meager pay of civil servants, and there is little possibility of enlisting men of outstanding qualification to serve on the Atomic Energy Commission. Men of courage, integrity, and high abilities are always difficult to find, with or without high salaries to persuade their services. But such men are found and they sometimes combine with their other qualities a sense of social responsibility stronger than the instinct for personal gain. It is naturally less difficult to induce men enjoying high private incomes to serve as public officials if the tasks for which they are enlisted are of pressing and evident national importance. Certainly a position that carries with it such responsibilities and powers as that of a member of the Atomic Energy Commission is not without its appeal to ambitious men—even conceding that private industry might set a value on their services equal to several times their official salary. "The reward of the general," Justice Holmes once remarked dryly, "is not a bigger tent but command."

Tenure and Removal Power

The first group of Commissioners appointed by the President serve two-year terms. Initially, as stated in the report of the Senate Special Committee, it seemed advisable to allow for a complete reappointment of the Commission after a short period, during which both the President and Congress would have an opportunity to view programs as they evolved and to determine whether the membership, as well as the organizational structure of the Commission, were satisfactory. Thereafter, assuming no legislative amendments involving structural changes, appointments are to be staggered as

to tenure, eventual nominations being for five-year terms, with one member appointed each year. This somewhat complicated scheme was designed to avoid disruption of the Commission's activities. It should be added that there is no limitation on the number of terms a Commissioner may serve.

The method operates as follows:

1. Five Commissioners appointed for the term 1946-1948.*

2. Five new appointments are to be made in 1948 for terms: 1948-1949, 1948-1950, 1948-1951, 1948-1952, and 1948-1953.

3. One new appointment is to be made in 1949 for five years to succeed the expiring appointment 1948-1949; one new appointment in 1950 for five years to succeed the expiring appointment 1948-1950, etc.

The President is expressly authorized to remove any member of the Commission "for inefficiency, neglect of duty or malfeasance in office." Should the President ever seek to remove a Commissioner on any other ground and should the action be taken to court, the issues presented would fall somewhere between two Supreme Court decisions, one upholding and the other denying the President's power. The legal question is whether the functions of the Atomic Energy Commission are quasi-judicial or quasi-legislative or whether they are clearly executive in character. If the former, then under the doctrine of *Humphrey's Executor v. United States,*† the President's removal power would be limited to the causes stated. If, on the other hand, the Commission is held to be an arm of the Executive, then under the principles of *Myers v. United States,*‡ the Act's attempt to limit the grounds of removal would be unconstitutional and the President could remove any Commissioner at will. In the most recent case, *Morgan v. TVA,*§ the court intimated that TVA's

* On October 28, 1946, the President nominated for two-year terms the following five Commissioners: David E. Lilienthal (chairman), William W. Waymack, Lewis L. Strauss, Samuel T. Pike, Robert F. Bacher. At the same time Carroll Wilson was appointed General Manager of the Commission. After protracted committee hearings, which included weeks of bitter attack on Lilienthal by McKellar, and a lengthy debate on the floor, the Senate finally confirmed all the appointments.

† 295 U.S. 602 (1935).

‡ 272 U.S. 52 (1926).

§ 115 F. (2d) 990 (1940), *cert.* denied, 85 L. ed. 1135 (1941).

powers (closely analogous to the Commission's) were essentially executive. That Congress intended the removal powers to be limited seems clear from the legislative history; the original McMahon-Douglas bill permitted removal "at the pleasure of the President," but this language was replaced by the narrower clause appearing in the final Act. Should the Myers case control, however, this expression of intent would become irrelevant.

Independent of the removal power, there is conferred upon the President, as will appear more fully, authority to overrule the Commission in all matters pertaining to the national defense. But the touchstone of effective cooperation between the President and the Commission is how infrequently he finds it necessary to use his authority. If the President's removal powers are in fact limited, whenever marked and irreconcilable differences of view as to policy arise between a Commissioner and the President, the President may be forced to use the veto power repeatedly to the detriment of the entire atomic energy program.

Organization Subordinate to the Commission

General Manager

The highest operating official of the Commission is a general manager, appointed by the President with the advice and consent of the Senate. Four officials, reporting to the general manager, are responsible for the divisions established in the Act—Research, Production, Engineering, Military Application.

While the general manager works under the general supervision and direction of the Commission, performing only such functions as may be delegated to him, it is evident that he must in fact be permitted to control operations with a certain degree of independence and autonomy. An obedient, wooden subordinate, lacking initiative and an independent sense of responsibility, would scarcely satisfy the purposes for which the post was designed. Congress left to the Commission unfettered authority to fix the manager's duties but evinced its intentions regarding the importance of the position

by requiring presidential appointment and fixing the salary equal to that of the Commissioners, the Chairman excepted.

The post was created to free the Commission, to the greatest extent possible, from the burden of administering current operations. In some measure this should mitigate the disadvantages of the multi-member form of control. But the outcome depends upon the Commission: how effectively it divides the execution of policy from its formulation; how much power it delegates formally; what independence of judgment and action it allows the general manager.

Conflicts will arise, almost certainly, if the Chairman intervenes unduly in operating functions. Clear and definite delineation of respective areas of responsibility is essential. The Chairman, the Commission, and the general manager must have separate orbits of action and authority. Where the paths of the orbits approach closely, every precaution must be exercised to avoid collision. However trite the principle, neglect of it will occasion serious and repeated breakdowns, as the unfortunate history of certain government units shows. (The melancholy experience of the Surplus Property Board is still a recent memory.)

The position of the Chairman of the Commission carries with it unique prestige and authority. The Chairman is not only the presiding officer of the Commission, participating in all its policy deliberations; he must also take the initiative in seeing to it that the Commission's policies receive effective administrative application. To this latter end he must work in close consultation with the general manager, keep him constantly informed of the decisions of the Commission, and together with him jointly plan measures required to translate these decisions into action. The other members of the Commission should not feel it their responsibility to advise and consult with the general manager except on matters relating to their own specialties or to keep themselves generally informed. For his part, the general manager must consider the Chairman as his immediate chief, the best qualified source of interpretation of Commission policies. He should submit to the Chairman his reports of daily operations and normally discuss with him problems affecting policies before submitting them to the Commission as a

whole. In such cases he and the Chairman will probably make joint recommendations to the Commission.

These illustrations are not intended to constitute a comprehensive survey of the relationships among the top officials of the Commission. The working pattern, many-sided and complex, is, no doubt, developing and undergoing changes as the various programs get under way. But whatever the character of the problems—scientific, industrial, legal, social, economic—a proper definition of individual functions and a clear delineation of authority and responsibility will reduce internal friction and contribute to the efficiency of the agency and the accomplishment of the major objectives of the Act.

Operating Divisions

The Act provides for the establishment in the Commission of four operating divisions—Research, Production, Engineering, Military Application.* The names of the divisions indicate the general nature of their functions, but no explicit charter of their responsibilities is given in the Act. This flexible disposition leaves the Commission free to allocate and reallocate duties and functions on the basis of working experience. In large measure the role of each division depends on the extent to which the Commission engages directly in the activities lying within its assigned field. Under the Manhattan Engineer District practically all production, construction, and research work was carried on by private contractors. The Commission's decision to continue and extend this practice necessarily resulted in the decision to have these divisions perform staff rather than operating functions.†

The functions of the divisions are considered more fully in succeeding chapters; here it will suffice to sketch the framework contemplated by the Act. ‡

* As of the date this note is written (August, 1947), the Commission plans to follow the recommendation of its Medical Board of Review in establishing a new division of medical research. At least one further division, with functions undescribed, is in contemplation. See this report, dated June 20, 1947, entitled Report of the Medical Board of Review, United States Atomic Energy Commission.

† Announced in the Commission's First Report to the Congress, January 31, 1947, p. 12.

‡ Thus far no organization chart or precise description of the functions of the several divisions or of the powers delegated to the General Manager have been

1. Full responsibility for all phases of production of fissionable material undoubtedly falls to the Production Division. Thus the Production Division should have primary responsibility for supervising management contracts for the operation of the Oak Ridge (Tennessee) and Hanford (Washington) plants and any new plants the Commission may construct. Incident to these functions the Director of Production appears best suited to exercise appropriate powers under Section 5(a) relating to fissionable material and to direct the acquisition and control of source material under Section 5(b). Under Section 4 the Commission must determine which of its production plants should be operated directly by the Production Division and which privately managed under the division's supervisory control.

2. Planning and construction of new production facilities are likely to be primary functions of the Engineering Division. Yesterday's marvels, the Oak Ridge and Hanford Plants, already are substantially outmoded as production units for fissionable material. The Engineering Division is, in all likelihood, charged with the planning, design, and construction or supervision of construction of improved production facilities, elaboration of new engineering techniques for production processes, engineering studies in the field of industrial applications of atomic energy, and other general engineering functions. The establishment of this division was urged upon the Senate Special Committee by witnesses whose advocacy was based on the operation of the Manhattan Engineer District.

3. In scientific research the Commission has a dual responsibility —to conduct its own research program and to promote independent research by supporting atomic energy projects of industry and universities. The Research Division is charged with the first of these functions. It is expressly prohibited from engaging in the second. Section 2(a)(4)(B) provides:

> The Commission shall require each such division to exercise such of the Commission's powers under this Act as the Commission may deter-

issued by the Atomic Energy Commission. Nor have the responsibilities of a number of offices, sections, committees, and boards, created to discharge internal administrative or advisory duties, been made public. See Second Semiannual Report of the United States Atomic Energy Commission, Eightieth Congress, First Session, Document No. 96 (United States Government Printing Office

mine, except that the authority granted under Section 3(a) [*i.e.*, to furnish research assistance to private or public institutions or persons] . . . shall not be exercised by the Division of Research.

This latter prohibition was based on the theory that it would be unwise to place the Division of Research in a position to determine how funds appropriated by Congress for research should be apportioned, as between governmental and private activities. Its proponents argued that research cannot be judged by the same standards as other government activities; that is to say, while in other fields it may be desirable to avoid competition between the government and private interests, progress in scientific research frequently depends on a concerted and cooperative attack on common problems by many scientists in different laboratories. Competition between scientists toward the same goal is likely to accelerate rather than retard its attainment. Under the circumstances a single unit of the Commission should not have the power to determine both the pace and scope of its own research program and that of its competitors. This dichotomy of functions was prescribed by the Act, in order that the Research Division might conduct the scientific projects of the Commission and formulate its own program just as would a private laboratory. It is to cooperate with other laboratories in the same spirit and toward the same end as scientists have always done. But it is not to control, financially or otherwise, research outside the government.*

* By continuing to operate its laboratories under private contract, however, the Commission appears to have diminished sharply the importance of the Division of Research and to have stripped it of functions contemplated by Congress. By express provision it cannot handle research contracts, and without direct research of its own, the division must be limited to advisory functions. The Commission's Second Semiannual Report to Congress refers to the Commission's "five principal laboratories": (1) Los Alamos, for atomic weapons and research in fundamental nuclear physics (operated by the University of California); (2) Argonne National Laboratory, Chicago, includes two experimental nuclear reactors (operated by University of Chicago); (3) Clinton Laboratories, Oak Ridge, Tennessee, possesses a nuclear reactor "responsible for producing important quantities of radioisotopes now being distributed to qualified applicants in nearly every part of the country" (fourteen universities are active in this program not including private industrial groups); (4) and (5) Brookhaven National Laboratory and Knolls Atomic Power Laboratory now under construction at Patchogue, Long Island, New York, and Schenectady, New York, respectively. Nine universities share the supervision of the Brookhaven National Laboratory. General Electric is to run (5).

The report also refers to "large laboratories under contract with the Com-

The Commission may decide to establish a separate committee to make grants for private research. But this is only the first, and the simplest, step. For splitting off the outside spending authority from the Research Division increases rather than diminishes the general requirement for planning and coordination of all research activities, public and private. Such a committee must be fully informed of the government's research program. It must also stay fully abreast of developments in the field of private research. This information must be joined by the Commission with an assessment of the level of contemporary scientific knowledge, the probable effects of relevant social and economic factors upon scientific progress to provide a basis for the Commission's own program, and the allocation of funds in the furtherance of this program. The subject is further considered in Chapter 9.

4. The Division of Military Application, as contemplated in the Act, is to engage in (1) research on military applications of atomic energy, including atomic bombs, rockets, and other carriers, and the use of atomic power for propulsion machinery in naval vessels, military aircraft, etc.; and (2) development and perhaps production of military weapons.

All wartime research on the atomic bomb, including direction of the Los Alamos Laboratories, which performed functions closely resembling those that fall to the Military Application Division, was in charge of the distinguished physicist, Dr. J. R. Oppenheimer, serving as a civilian. It was taken for granted that the direction of a program of such a complexly scientific character lay outside the competence of the professional soldier. Nevertheless, the Act provides that the Military Application Division shall be directed by a military man. The explanation of this provision is not to be found by a resort to logic but by reference to the necessity for compromise in the democratic process. As it became increasingly evident to the proponents of the thesis that atomic energy is primarily a military weapon that they would lose the fight to place soldiers on the Commission itself, they insisted more and more vigorously that the

mission at Berkeley, California; Ames, Iowa; Dayton, Ohio; and Hanford, Washington."

Military Application Division, at least, must be headed by a military man. And, at some minor expense to logic, they carried their point.

Subsection (d) of the organization section sets forth accordingly that, notwithstanding provisions of earlier laws, "any active or retired officer of the Army or the Navy may serve as director of the Division of Military Application . . . without prejudice to his commissioned status as such officer." He receives, in addition to his pay as a member of the armed forces, an amount equal to the difference between that pay and the compensation provided for division directors.

Since it is unlikely that any military man would consider himself competent to formulate and pass on research programs or to direct a large nuclear research laboratory, it may be assumed that the director of the Division of Military Application acts as administrative head of his division and has among his principal deputies trained scientists to whom he can entrust the supervision of research functions.

The functions of the Division of Military Application will be considered more fully in the analysis of Section 6 of the Act (Chapter 11). At this point, it is convenient to note that, while the Act prohibits the Division of Research from exercising any authority with respect to the support of independent research activities, the Division of Military Application may exercise this authority. Why this prohibition should apply in the one case and not in the other is not clear, especially in light of the fact that the Military Application Division operates in a field in which the Army and the Navy are undertaking research programs, both directly and through contracts with private industry, with the resultant possibility of competition.

Military Liaison Committee *

The provisions establishing the Military Liaison Committee were compromised out of the bitterly contested struggle described in

* The Military Liaison Committee appointed by the Secretaries of War and Navy had the following membership as of September 1, 1947: Lt. Gen. Lewis

Chapter 1. The form of this compromise is no more logical or satisfactory than might be expected, since it is the nature of compromises to blur issues and to leave open the possibility of more than one outcome. The provision finally adopted can be fully understood only after a consideration of the proposals it supplanted and the differences it sought to reconcile. The essential elements of this provision have been indicated in the previous chapter. Here they will be analyzed in more detail.

During most of the period the May-Johnson bill was in the drafting stage the country was at war. Almost all that was known of atomic energy related to its use as a weapon, and after the attack on Hiroshima it was fear, perhaps partly engendered by a sense of guilt, that colored all consideration of the problem of its control. While it was recognized that atomic energy would, in all probability, have great peacetime uses, overwhelming importance was attributed to security—"keeping the secret"—and to furthering the military development of atomic weapons so that the nation might preserve its advantage in time and technical progress. Conceived in a tense, nervous atmosphere and polarized toward military objectives, the May-Johnson bill constituted a serious threat to the traditional principle of exclusive civilian control of the administration of the United States government.

By a statute passed in 1870, subsequently implemented and reaffirmed by provisions of other laws, any active officer of the Army or the Navy is prohibited from serving in a civilian post of government * while retaining his rank and privileges in the service to which he is attached. In a specific instance it is possible to remove the disqualification by passing a special law permitting a named member of the armed forces to serve in a post to which the President wishes to appoint him, and this procedure has been not infrequently followed, particularly within the past few years. The May-Johnson bill, however, contained a sweeping provision repealing the law of 1870, so far as it pertains to the Atomic Energy Commission,

H. Brereton, USA, chairman; Maj. Gen. Leslie R. Groves, USA; Col. John H. Hinds, USA; Rear Adm. Thorvald A. Solberg, USN; Rear Adm. Ralph A. Ofstie, USN; Rear Adm. William S. Parsons, USN.

* 10 U.S.C. § 576, 1940 edition.

and authorized the President to appoint members of the armed forces either to the Commission or to its staff. Senate confirmation would still have been required for appointments to the Commission or the post of administrator, but it is evident that, had the May-Johnson bill been adopted, the Senate would hardly have undertaken to reject a presidential appointment on the sole ground that the appointee was an officer of the Army or the Navy. Thus, even though the May-Johnson bill made military appointments permissive rather than mandatory, in effect it embodied a principle fundamentally at variance with the traditional nature of our system.

The brief for military membership rested on the major premise that the military departments of the government have a *primary* responsibility for the national defense. This premise is of course false, for the Constitution gives *Congress* the power "to provide for the common defense"; "to raise and support armies . . ."; and "to provide and maintain a Navy"; and the President is responsible for the conduct of foreign relations, which in the first instance determines national defense requirements, and is Commander in Chief of the Army and the Navy. What the War and Navy Departments have is a *delegated* responsibility, traditionally confined to the training, maintenance, and deployment of the armed forces in accordance with the directives of the President. Matters of policy affecting the broad national interest lie wholly outside the scope of authority of the military departments. Even issues of purely internal organization within the Army and the Navy are either for the decision of the President or authority to dispose over them must be conferred specifically by statutory enactment of Congress. During the last war Congress issued to the Army and the Navy numerous broad grants of power. Nonetheless, in the exercise of a function so vital to the military effort as that of procurement, the service departments, so far from having independent authority, were required to apply for allocations of men and materials to civilian agencies such as the Selective Service System and the War Production Board. The Army and the Navy came as claimants and petitioners and, however much their claims and petitions were favored, they were not empowered to fix allocations or determine their own priority.

The bill (S.1717) introduced by Senator McMahon (and subsequently in the House by Congresswoman Helen Gahagan Douglas) on December 20, 1945, which, after some revision, became the Atomic Energy Act of 1946, differed from the May-Johnson bill so far as organization of the Commission was concerned in providing for full-time, all-civilian membership. The statutory technique consists simply of omitting the exemption for members of the armed forces contained in the May-Johnson bill, thus leaving in effect the prohibition of the law of 1870. To be sure, this does not prevent the President from appointing a military man to the Commission if he considers him uniquely qualified. But in that case there is required, just as in appointments to other civilian posts, a special act of Congress exempting the appointee from the restrictions of existing legislation.

The basic difference between the two approaches lies in this: Under the May-Johnson bill the President would have been justified in making military appointments to the Commission as a matter of course, pursuant to approval of the principle in advance by Congress; under the Atomic Energy Act, since traditional policies remain in force, special legislation is required for every military appointment, and only *special* circumstances or unique qualifications on the part of the appointee would justify the choice of a soldier.

The violence of the conflict between the proponents of these opposing measures has already been described. A statesmanly compromise was obviously called for, and Senator Vandenberg, the most influential Republican member of the Senate Special Committee, undertook to draft one. His intention was to preserve the essentials of civilian control while making absolutely sure that the War and Navy Departments would have all the information and authority that the most pronounced distrust of the international situation and the strongest concern for security and military preparedness could dictate. To accomplish these objectives he submitted the proposal, which quickly became famous as the Vandenberg amendment.

In its original version, however, this amendment, which provided

for the establishment of a Military Liaison Committee composed of representatives of the War and Navy Departments, conferred such broad powers on the Committee that it was commonly regarded as more dangerous to the principle of civilian control than the May-Johnson bill itself. The members of the Military Liaison Committee had the power to inform themselves of *every decision* and *every action* of the Atomic Energy Commission. If "any action, proposed action, or failure to act" on the part of the Commission was deemed unsatisfactory by the Committee, it was authorized to make its own recommendations. If these were not followed by the Commission, the Committee could appeal *directly to the President.* In effect, the Committee would become the monitor of all the Commission's activities. Wherever its judgment on policy differed from that of the Commission, it could appeal the matter directly to the President, completely disregarding the Secretaries of War and the Navy. Not even the Attorney General was to be consulted on the scope of statutory military responsibility, which in theory at least underlay the Committee's powers. The President alone could set aside the Committee's veto and even he could not bound or restrict the Committee's activities.

The tempestuous public reaction to this measure upon its adoption by the Senate Atomic Energy Committee has already been described. Under this stimulus Senator Vandenberg was prompted to reexamine the entire issue. After conferring with numerous high military officials and scientists and with his colleagues on the Committee, he proposed certain substantial modifications of his original amendment. These, in turn, were discussed at length, debated, and several times rewritten in Committee before the present version emerged. The section as unanimously adopted by the Senate Committee is not altogether felicitous in phrasing nor clear in intent; it completely satisfied no one and left many seriously disturbed. "The difference between the right word and the almost right," said Mark Twain, "is the difference between the lightning and the lightning bug." Here the lightning bug is in evidence.

The Military Liaison Committee, appointed by the Secretaries of War and the Navy, is to consult with the Commission on all activities *relating to the military applications of atomic energy.* These include the development, manufacture, use, and storage of bombs, the allocation of fissionable material for military research, and the control of information relating to the manufacture or utilization of atomic weapons. The decision as to whether individual matters fall under any of these headings remains exclusively with the Committee.

The *Committee* must keep the *Commission* informed of all atomic energy activities of the War and Navy Departments. This is indispensable; for unless the Commission has full knowledge of the activities of other government departments in the field of atomic energy, it cannot be expected to exercise its control and coordinating functions properly.

Section 2(c) further provides that the Committee may make recommendations to the Commission in areas affecting the responsibility of the War and Navy Departments; if these are rejected and the Committee believes such rejections to be adverse to the responsibilities of the War and Navy Departments, the Committee may *turn its recommendations or protests over to the Secretary of War or the Navy.* "If either Secretary concurs, he may refer the matter to the President, whose decision shall be final." Thus, the Military Liaison Committee must channel its recommendations through the civilian heads of the military departments and cannot deal directly with the President.*

Comparing the original Vandenberg amendment with the provision adopted by Congress, it might appear that the essential elements of the earlier version escaped significant modification and that public protest was quelled with only a token concession. Such

* In July, 1947, the Eightieth Congress passed a unification bill, subsequently signed by the President, merging the Army and Navy into a single department of defense embracing the National Military Establishment. Under this Act there is created a new cabinet post of Secretary of Defense, under which are subsumed the Secretaries of Army, Navy, and Air Force (a new and coequal department). It is not yet known how this reorganization affects the channels of action prescribed in Section 3(C), but there is little doubt that the functions of the Military Liaison Committee will remain substantially untouched. Whether appeals in the first instance run to one of the three subordinate secretaries or to the Secretary of Defense should, in practice, make little difference.

is not the case, however; the compromise was a genuine one. The concessions in the direction of limiting the power of the military may be listed as follows:

1. Defining by illustration the scope of the term "military applications," the section imposes limitations on the area in which the Military Liaison Committee may operate, even though the boundaries are not fixed precisely.
2. There is a reciprocal responsibility on the part of the Committee and the Commission, each to keep the other informed of all atomic energy activities within the province of its own special knowledge.
3. The Committee's extraordinary authority to appeal directly to the President is eliminated. It can appeal only to the civilian heads of the War and Navy Departments.
4. Appeals to the President for alteration of the Commission's policy can be made only through the Secretaries of War or the Navy. As the President's principal lieutenants in the field of defense, it is both appropriate and desirable that they be informed of the activities of the Commission that relate to their responsibilities. Even if there were no Military Liaison Committee, the Secretary of War (or the Navy) would, as a matter of course, consult with the President regarding the policies of the Commission. Under the procedure established by the Act, many atomic energy matters will be decided, as they should be, between the Secretaries of War and the Navy and the Commission without burdening the President. Thus, the Military Liaison Committee should discharge the function implied by its name—that of keeping the President's principal representatives in the military departments informed of the activities of the Atomic Energy Commission relating to national defense.

As with so many of the provisions of the Act that attempted to reconcile fundamental differences, the formula that emerged from the protracted controversy over the extent of military control over atomic energy affords no ultimate solution to the problem. The form is plastic and it will be shaped by the pressure of events and the temperature of opinion.

GENERAL ADVISORY COMMITTEE *

Despite its admitted drawbacks, the Commission form of organization was adopted on the ground that, in formulating policies and programs in a new and experimental field, diversity of judgment and experience would be needed in the control unit. Congress was convinced that the best method meant a full-time civilian commission, not dominated either by scientists or men of technical experience. But it was also impressed by two other factors: First, that it would be difficult to obtain for the divisions the full-time services of certain outstanding scientists and technicians because of their probable unwillingness to give up positions in universities or industry; and, second, that technical advice from these men as well as other sources outside the government would be highly useful not only to the Commission but to the operating divisions. These considerations led Congress to establish a General Advisory Committee, composed of civilian advisers to be appointed by the President, to meet at least four times a year and consult with the Commission on scientific and technical matters relating to materials, production, research, and development.

By this means the Commission, in furtherance of its complex and specialized programs, is enabled to draw upon the advice of leading specialists throughout the country, otherwise unavailable. At the same time, the fact that the Committee is advisory only permits adherence to the essential principle that those who formulate and decide government policies must not have divided responsibilities to public and private interests. To be sure, the words of the Act will not alone determine the matter. The Commission must sustain the

* On December 12, 1946, the President appointed the following General Advisory Committee: Dr. J. Robert Oppenheimer (director of the Institute for Advanced Study, Princeton University), chairman; Dr. James B. Conant (president of Harvard University); Dr. Lee A. Du Bridge (president of California Institute of Technology); Dr. Enrico Fermi (professor of physics at the Institute for Nuclear Studies, University of Chicago); Dr. I. I. Rabi (chairman of the Department of Physics, Columbia University); Mr. Hartley Rowe (vice-president and chief engineer of the United Fruit Company); Dr. Glen T. Seaborg (professor of chemistry at the University of California); Dr. Cyril S. Smith (director of the Institute of Metals, University of Chicago); Mr. Hood Worthington (Carothers Research Laboratory, E. I. du Pont de Nemours & Company, Inc.).

principle in practice. The Committee must, in fact, remain an advisory body. If, by virtue of the prestige of its members, it grows to overshadow the Commission or is permitted to become a major participant in policy formation or operations, the result will be little less than a "return to Egypt from which we have been so happily delivered."

3. Defining the Control Problem

We thus come to an unexpected conclusion that *from the viewpoint of alchemical transformation, all chemical elements with the exception of silver are in a metastable state, and can liberate vast amounts of hidden internal energy either by fusing together (lighter elements), or by breaking up through the process of fission (heavier elements)*. . . . We find now . . . that we live literally inside an alchemic powder magazine where practically every substance, be it a glass of water, a slice of bread, or a piece of iron, is loaded with terrific amounts of energy which only await the chance to be liberated. The sun and all the other stars are using this hidden energy for supporting their eternal radiation of light and heat into surrounding space, and now, 3,000,000,000 years after the creation of the universe, the uses of this energy are being developed for its own purposes, by a small but ambitious lump of organic matter on the surface of the earth, which calls itself: man.

G. Gamow, *Atomic Energy in Cosmic and Human Life* (Macmillan, New York, 1946), pp. 36-37.

When the Senate Special Committee on Atomic Energy was formed, its Chairman, Senator McMahon, announced that members would have to go to school to learn the facts about this new subject. Considering the acknowledged erudition of certain of the committee members and the status that most of them enjoyed as elder statesmen, the proposal may have appeared inappropriate. Actually, there are many facts of a primarily technical nature, indispensable to the framing of an effective system for the control of atomic energy, that were completely unknown to laymen and at that time largely unrecorded. It is doubtful that the Senators' zeal for education carried them very deeply into the theory of nuclear fission or

made them technical experts in the assembly of the bomb. It can be said, however, that the bill they unanimously reported demonstrated a grasp of those fundamental factors that determine to a considerable degree the necessary framework of the control system.

The problem of controlling atomic energy, although complex and formidable in the extreme, is, as the Acheson-Lilienthal report pointed out, not without definable boundaries. The secret of atomic energy, "long mercifully withheld from man," has even now been revealed only in part. Professor Gamow's alchemic powder magazine—this new Pandora's box into which men have been audaciously prying—has many compartments, and so far the lid has been loosed on only one. The secret of fusing the lighter elements to produce the release of atomic energy has thus far escaped us entirely. And of all the heavier elements, the splitting of which might release Promethean forces, it is, in effect, only uranium to which we have been able to fit a trigger. (Actually, as will appear, there are certain other fissionable materials, but if it were not for uranium the release of atomic energy would be no more than a laboratory experiment.)

It is the fact that in the present phase of scientific development the large-scale release of atomic energy requires substantial quantities of uranium,* procurable only from the relatively limited number of large deposits, which sets limits to the problem of control and holds it to dimensions with which the human mind can struggle with some hope of mastery. This fact is central, but there are a number of other facts that contribute to the definition of the control problem. The technical factors that set the pattern of controls established in the Act may be summarized as follows:

1. Uranium, because of the ability of its atoms to undergo fission on capture of a neutron of appropriate velocity, is the most im-

* Apparently, if large quantities of thorium are available, the amount of uranium required need not be great. Adequate data on this point was never given the Senate Special Committee and published information remains very sketchy. Although the question is one of great importance to the international control of atomic energy, it has very little effect on the domestic problem, since the United States is reported to be almost completely lacking in commercial deposits of thorium. (See Chap. 5)

portant source material known and the critical element used in the atomic bomb and in atomic power production.

2. Three other elements—thorium, protoactinium, and plutonium—possess the fission characteristics of uranium. Of these elements, however, plutonium is derived from uranium, protoactinium is of such rare occurrence in nature as to be of negligible significance, and thorium can be made to sustain a chain reaction only in association with uranium. Consequently, in the present stage of scientific knowledge, uranium is indispensable to the large-scale release of atomic energy.

3. Uranium exists in deposits of varying richness throughout the world. Traces of uranium are everywhere, occurring in approximately four parts per million throughout the earth's crust. However, only the relatively few large and concentrated deposits are of significance for the large-scale release of atomic energy.

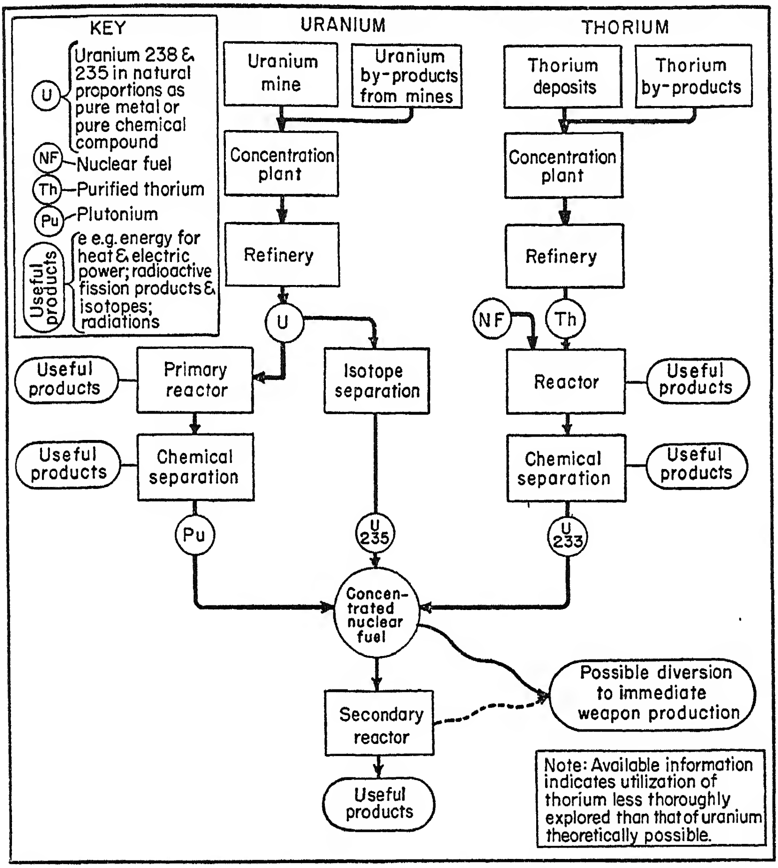
4. As an ore, uranium is usually found as an oxide associated with other metals. Refining is necessary to produce the pure metal.

5. Uranium metal is composed of three isotopes: U-238, which makes up more than 99 per cent of the total; U-235, which accounts for about 0.07 per cent and U-234, which occurs in such minute quantities that it does not require consideration. The isotope U-235 can sustain a chain reaction; however, pure uranium and the isotope U-238 cannot.

6. Significant quantities of fissionable material can be produced by extracting U-235 from uranium metal, by transmuting U-238 into plutonium (Pu-239), or by transmuting thorium into U-233. These processes require elaborate and expensive installations, and none is possible without U-235. The processes by which source material is transformed into fissionable material—or "concentrated nuclear fuels"—are graphically depicted in the following Atomic Energy Flow Chart. Certain other materials can be made fissionable by enrichment above a threshold level with one of these substances.

7. The production of fissionable material is a hazardous process. The materials because of their high radioactivity are dangerous to

handle, and because of their enormous explosive potential would constitute an intolerable threat to public safety if they fell into improper hands.



Atomic Energy Flow Chart.

8. In the production and also in the utilization of fissionable material quantities of radioactive materials are incidentally generated. These radioactive by-product materials are of great value for research, medical therapy, and industrial uses. They are not

explosible and, used by trained personnel under proper conditions, they are not dangerous.

9. The demonstrated feasibility of utilizing atomic energy for the production of power is only one of many possible industrial applications that may profoundly affect billions of dollars of capital investments and ultimately transform the structure of our economy.

These primarily technical factors accounted in large measure for the nature of the system of controls adopted in the Act. This is not to suggest that in and of themselves they were sufficient to generate what by accepted American standards must be accounted a radical program.

A more powerful motivation was required to bring about this end; it was supplied by fear for the nation's security. In the course of the Committee's schooling it no doubt received a good deal of information and admonition on the military implications of atomic energy. However, the point that the atomic bomb is terrifying beyond imagination did not need to be labored. It was recorded adequately in the wasted bodies, the twisted members, the ashes, and the debris of Nagasaki and Hiroshima. If the Committee members were less sensitive than John Hersey in registering all the implications of this record, they had to be no more imaginative than millions of their constituents to feel an apprehensive dread in their hearts.

The somber fear that the cities of the United States might be the Nagasakis and Hiroshimas of a future war brooded over their deliberations. It rode them hard and drove them far from the comfortable ancestral concepts of the paramount rights of private property, the spontaneous benefits of unregulated enterprise, and the inherent malevolence of bureaucracy. It converted such stalwart defenders of the established order of things as Senators Byrd and Millikin into firm supporters of a bill described by certain of their colleagues in the House as smacking of the Commissariat. To understand how the controls provided in the Atomic Energy Act could have been unanimously reported by the members of a Special Committee whose members by and large stood some degrees right of

center and passed by a Congress obsessed by the determination to rid the country of government controls, it cannot be too often emphasized that there was one consideration that overrode all others, and that was national defense.

As indicated in the enumeration of significant technical factors above, there are many operations connected with the production of fissionable material and the release of atomic energy. These include processes as diverse as the transmutation of U-238 into the fissionable material, plutonium, with its concomitant release of vast stores of power and deadly emanations, and the utilization of minute quantities of radioactive by-product materials in medical therapy. The danger to health and safety and to the national security incidental to one operation is obviously far more acute than that attendant upon the other. The attempt made in the Act to fit the stringency of the control system to the acuteness of the danger produced the general pattern described below.

1. An absolute government monopoly of all fissionable material * and of all (except research) facilities for the production of such material is established. Neither the material nor large-scale facilities used to produce it can become private property. Fissionable material may be loaned or leased for various approved purposes, but the government's ownership right and control remain absolute. Private *possession* of dangerous quantities of fissionable material (*i.e.*, quantities sufficient to make a bomb or a military weapon) is prohibited. Patent rights for all inventions useful solely in the production of fissionable material, or in the use of fissionable material for military purposes, are also abolished. The object of these provisions is, of course, to reduce to a minimum the activities of individuals in this field fraught with the greatest danger to public health and safety and to national security.

2. A license from the Commission is required to transfer or deliver after removal from its original place in nature any source material † (*i.e.*, uranium, thorium, and any other material de-

* See chart of Fissionable and Source Materials for a summary classification of the materials that are included in these terms as they are used in the Act.

† See chart of Fissionable and Source Materials for complete list.

FISSIONABLE AND SOURCE MATERIALS

Substance	*Denominated fissionable material*	*Denominated source material*	*Danger-ous*	*Used in bomb*	*Atomic power*	*Research*
1. Uranium or thorium ore	No	Yes, if uranium or thorium present is above concentration specified by Commission	No	No	No	Yes
2. Pure uranium metal or thorium	No	Yes	No	No	Yes	Yes
3. U-238	No	Yes	No	. . .	Yes	Yes
4. U-235	Yes	No	Yes	Yes	Yes	Yes
5. Plutonium	Yes	No	Yes	Yes	Yes	Yes
6. U-233	Not in the Act *	No	Yes	. . .	Yes	Yes
7. Protoactinium	Not in the Act *	Not in the Act †	Yes	. . .	. . .	Yes
8. Other elements	Not in the Act *	Not in the Act †	. . .	. . .	. . .	. . .
9. Other ores	No	No	. . .	. . .	. . .	. . .
10. Compounds containing 3, 4, 5, 6, 7, 8	Yes, for any substance enriched in U-235, plutonium, or any other element denominated a "fissionable material"	Yes, if containing elements denominated "source material" above concentration specified by Commission	Yes	. . .	Yes, for 4, 5, and 6	Yes

* At discretion of Commission, may be denominated "fissionable material" if capable of releasing substantial quantities of energy through nuclear chain reaction of the material.

† If determined by Commission, with approval of President, to be peculiarly essential to production of fissionable material.

nominated as "peculiarly essential to the production of fissionable materials"). Ownership and mining of source ores are not affected. The Act becomes operative only at the point where the physical location or the ownership of the material is transferred. From that point on to where the Commission itself takes possession of the material, every operation to which it is subjected is under the licensing control of the Commission. If necessary to effect the purposes of the Act, the Commission may requisition or condemn supplies of source material or property containing deposits of source material. The effect of these provisions is to control the flow of source material into approved channels, to guard against waste, and to provide a continuing supply.

3. The Commission is authorized to distribute by-product materials (that is, any radioactive material—except fissionable material —created in the production or the utilization of fissionable material) for research or development activity, medical therapy, industrial uses, etc. The Commission is charged with the duty of making sure that proper health and safety standards are observed by the users of this material and that the material is utilized only for approved purposes. These provisions enable the Commission to effect the utilization of by-product materials for the most desirable purposes and to maintain supervision over all individuals, institutions, and concerns utilizing these materials.

4. The utilization of atomic energy for practical industrial purposes may be licensed by the Commission only after Congress has been allowed ninety days to consider the proposal to grant such a license. When it seems to the Commission that developments in a certain field have reached the point where industrial or commercial applications would be feasible, it is required to submit to the President a report setting forth all the facts with respect to the contemplated use of atomic energy and the Commission's estimate of the social, political, economic, and international effects of such use. The President transmits the report to Congress, together with his recommendations, and if in ninety days the Congress has taken no negative action, the Commission may issue licenses. This provision reflects the recognition that developments in the field of atomic

energy may make certain existing industrial processes completely outmoded and in so doing wipe out large capital investments, cause serious unemployment, or create profound social disturbances. It is designed to give Congress full opportunity to consider the possible consequences of a contemplated practical use of atomic energy before the use is authorized.

This short summary is intended to indicate only the general pattern of controls prescribed by Congress. More detailed discussion appears in the succeeding chapters on fissionable material, source material, by-product materials, and industrial and commercial uses.

4. Fissionable Material: Production and Ownership

The Socialists contend rightly that certain forms of property should be reserved to the state, since possession of them carries with it a kind of power too great to be left to private individuals without grave danger to the community in general. Just demands of this sort contain nothing that is opposed to Christian truth.

Pope Pius XI, *Quadragesimo anno*, May 15, 1931.

Let me add that I think that the distinction is wisely drawn in S.1717 between the realm of discussion and experimentation, where freedom is the only safe rule, and the realm of applied technology, where, in a matter that involves the national safety and welfare so vitally, social control is essential. The control that S.1717 would impose upon the commercial production of fissionable materials and their utilization in industrial channels seems to me to be entirely justified. If the push of a button can destroy a city, no nation can afford to leave the button in private hands. That would amount to an abdication of sovereignty.

Secretary of the Interior, Harold Ickes, testifying before Senate Special Committee on Atomic Energy.

Definition

Fissionable material, it has been seen, is the core of the control problem; the definition of fissionable material, consequently, is central to the entire Act. The discussion in the previous chapter has indicated what materials—in the present stage of scientific knowledge—are fissionable, and it has emphasized the indispensability of uranium to the release of atomic energy on a large scale. On the basis of these data it would be readily possible to draw a definition

of fissionable material adequate for the present although even this task would not be without difficulties. Certain materials not of themselves fissionable become so when enriched above a certain level with U-235 or plutonium, and security considerations do not permit revelation of this threshold amount. However, in view of the elementary state of present knowledge of nuclear physics and the likelihood of further developments in this experimental and fluxional field, Congress would have been ill-advised to assume that the list of fissionable materials it was then able to draw would have permanent validity.

The opposite alternative to the attempt to categorize all fissionable materials would have been to entrust to the Commission complete discretionary authority to draw its own definition. In effect, Congress combined both elements in the definition it framed, listing the materials currently known to be fissionable (with due regard to security considerations) and conferring upon the Commission authority to amplify the list as it deemed advisable. Fissionable materials are enumerated as

1. *Uranium enriched in the isotope* 235. In other words, uranium that, as result of technical processing, contains more than $\frac{7}{10}$ of 1 per cent of the dangerous isotope, U-235. Note that there is no reference to threshold amounts; the product of any process that enriches uranium in the 235 isotope is fissionable material. So far as the Act is concerned, whether or not the uranium so enriched is in fact capable of sustaining a chain reaction is irrelevant.

2. *Plutonium.* This element, not found in nature (except possibly in insignificant traces) but produced artificially by transmutation of uranium, is included without qualification.

3. *"Any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material."* The Commission is thus given authority to act as a court of scientific judgment and to modify its rulings in order to meet changed conditions growing out of future discoveries.

4. ". . . *or any material artificially enriched by any of the foregoing.*" Any material to which there have been added amounts of fissionable material, as previously defined, is denominated "fissionable" for the purpose of bringing it under the controls of the Act. Again, whether these materials are capable of sustaining a chain reaction is irrelevant.

Around this central point, the definition of fissionable material, is arranged the entire control pattern of the Act. The definition determines the boundaries of government ownership of materials and facilities in the general field of atomic energy, and it adumbrates the system of governmental controls in the area left to private ownership. It was framed in the manner of an axiom or postulate in mathematics, upon which, as foundation, a sound superstructure might be erected. How well the definition serves the purpose for which it was intended will appear in the analysis that follows. (The effects of this definition in determining who may and who may not own or operate production facilities, and own, possess, and use fissionable material, are summarized in the chart on pp. 60 and 61.)

The Bases of Policy

The quotation that heads this chapter was taken from the testimony of Harold Ickes before the Senate Special Committee on Atomic Energy, early in 1946, while he was still Secretary of the Interior. Mr. Ickes, intemperate reformer and paladin of the New Deal, had ridden the left flank of the Democratic Party ever since his belated initiation, and even during the heyday of his Chief his truculent defense of the public interest against what he considered private greed had aroused alarm among members of his own party who did not think it necessary to draw the line between the two spheres with as sharp an instrument as Mr. Ickes wielded, while spreading consternation and occasional hysteria among the opposition. But on this occasion, while pronouncing doctrine of a radical portent beyond all his earlier utterances, Mr. Ickes received nothing but sympathetic agreement from a Senate Committee that cer-

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Who May Produce and Own Fissionable Material

Key:
- √ Permitted
- X Prohibited
- F.M. Fissionable material
- B.Q. Bomb quantities
- N.B.Q. Nonbomb quantities
- R For research and development purposes without license
- M For medical therapy without license
- I For industrial use under license
- A The Act does not *prohibit* government departments from engaging in this activity. Specific authority, in each case, must be derived from other laws or appropriation acts, except that authority may, under appropriate circumstances, be inferred from Section 12(a)(6) of the Act.

	Produce						*Own (and possess)*				
	Produce in Bomb Quantities	*Operate Commission facilities under management contract*	*Own facilities*	*Manufacture production facilities*	*Produce F.M. incident to Research*	*Manufacture * military devices (Not including F.M.)*	*Own †*	*Possess and use*	*Import*	*Export*	*Transfer*
Commission.......	Exclusive (as directed by President)	Not applicable	√ B.Q. and N.B.Q.	√	√	As directed by President at least annually	Exclusive	√	√	X	√

tainly had no leftward inclination whatever. He advocated nothing less than state socialism for atomic energy—a force that will ultimately transcend in importance to our economy coal and water power combined. And while no one acknowledged Mr. Ickes's statement for the Committee by quoting Lord Haldane's somewhat exaggerated characterization of Parliament a half century ago—"We are all Socialists here"—nevertheless, so far as the Committee's charter extended, the quotation would have assuredly applied. It may well be that among all the miraculous transmutations ultimately to be worked in the field of nuclear physics none will surpass the mysterious alchemy whereby a group of Senators, most of whose names are anathema to the left-wing press, were without exception transformed for a time into state Socialists.

Under the compulsion of a necessity they could not escape, Congress established a state monopoly of the means of producing fissionable material and of the material itself. In the search for the most conservative of all ends—security—it was found necessary to adopt these radical means. The declaration of policy makes it clear that the Act has "the paramount objective of assuring the common defense and security." This purpose is overriding. It dictates an impressive list of restrictions and controls designed to cope with the abuses and dangers it was possible to anticipate would attend this enormous destructive force.

Nevertheless, the Act contains explicit and adequate acknowledgment of the constructive potentialities of atomic energy and gives the Commission full responsibility and adequate authority to achieve these potentialities. But of positive guidance and specific standards to be followed the Act is markedly deficient for the inescapable reasons already set forth in the introduction.

When the Commission is faced with the task of determining its production program and fixing its policy governing the distribution of fissionable material, it will have for guidance nothing save the sonorous generalities set forth in the policy declaration—phrases such as "improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace." It is to be feared that these precepts

resolve few of the Commission's doubts as it undertakes to decide the various issues with which it is confronted in the planning of its programs.

Consider some of the decisions the Commission must make. It must determine the total quantity of fissionable material to be produced and make provision for adequate quantities of source and other materials, labor, power, and facilities. It must assess the adequacy of existing facilities to meet its planned programs and perhaps undertake to get appropriations for expansion. Consideration must be given to the effect of the production program (and particularly of plant expansion) on the economy as a whole and on international relations. Unless production is limited by these considerations, it is probable that for the foreseeable future plants will be run at full capacity but will nevertheless be unable to supply all the materials for which there is legitimate demand.

In the distribution of fissionable material, the Commission must bear the kind of burden under which the Civilian Production Administration faltered and failed in the months following V-J Day. It must operate an allocation system that makes value judgments among various types of uses and weighs the advantages of satisfying current needs so far as possible against probable long-term needs that can only be met by the stockpiling of a portion of the inadequate supplies available from current production. In distributing fissionable material among claimants, research requirements of the Commission, other government departments, and independent private laboratories, medical requirements for therapy and experimental work and industrial requirements for various applications, including power and heat, must be assessed.*

It is clear that the operations of the Commission in the production and allocation of fissionable material must have very consider-

* For good or ill the Commission's production planning is currently simplified by its announced policy of devoting almost its entire resources to the manufacture of atomic weapons. When and if the tensions of the international situation and corresponding domestic political pressures abate, the Commission will have the agreeable opportunity of exercising the value judgments referred to above. But not until then. See Second Semiannual Report of the United States Atomic Energy Commission, Eightieth Congress, First Session, Document No. 96 (United States Government Printing Office, Washington, 1947).

able political effects. Its actions will be (and are) subject to critical scrutiny and not infrequently to frenzied protest. In these cases, the vagueness of the Act certainly makes the Commission's position more vulnerable. There are, to be sure, certain provisions in the Act that can protect the Commission from some of these pressures and, more important, serve to bring its actions into consistent line with the general policies of the Administration.

Very broad powers have been conferred on the President to overrule the decisions of the Commission and make final dispositions in matters affecting the national defense and security. These have been described in the course of the discussion of the Military Liaison Committee.* Here it is only necessary to recall that it is the President who fixes the rate of atomic bomb production and thus in effect fixes the allocation of fissionable material for military purposes. In Section 4(c)(2) it is provided that "The President shall determine at least once each year the quantities of fissionable material to be produced under this paragraph."—*i.e.*, all fissionable material except that produced incidental to research activities. This provision should assure that the production policy is consistent with the general economic and fiscal policy of the government—*e.g.*, that a great expansion program should not be undertaken by the Commission at a time of general retrenchment and that adequate consideration should be given to the effects of the Commission's proposed policy on foreign relations. It is not to be expected, of course, that this presidential review should extend to the details of the proposed allocation system for fissionable material.

Government Monopoly of Production Facilities

In the previous chapter we accounted for the curious paradox that conservative men, actuated by the most profoundly conservative of all emotions, the desire to achieve security, were forced to resort to the radical expedient of state socialism. The reasoning whereby the Senate Committee arrived at the conclusion that atomic energy is too powerful to be left to private individuals is set forth

* See Chap. 2, p. 39*ff*.

in the report in which they recommended the enactment of S.1717, the McMahon-Douglas bill. Since the members of the Committee, by virtue of their prestige and influence both in Congress and in the country, were largely responsible for the passage of the Act in a form close to the bill they recommended, this report assumes unusual significance as an historical document.

From the start of its deliberations the Committee has been convinced that an absolute government monopoly of production of fissionable materials is indispensable to effective domestic control of atomic energy. A number of factors point unmistakably in this direction:

1. Fissionable material is the principal ingredient of the atomic bomb. Thus, to permit private manufacture of fissionable material would be to permit private manufacture of material of enormous destructive potentialities.

2. The production of fissionable material is attended by serious hazards to public health and safety. The responsibility for minimizing these hazards is clearly a government function.

3. The future production of fissionable material is closely interrelated with the possibility of achieving effective and reciprocal international safeguards against the use of atomic weapons. It is undesirable, therefore, to permit private development in an area which may soon be placed under Government control by reason of international agreements.

4. The production of fissionable material is technologically in its infancy; unforeseen and unforeseeable factors may play a great part in its development. To permit decontrol and decentralization of this activity, and weaken continuing Government supervision, would be contrary to the principle of prudent stewardship demanded of the Government by considerations of national defense and national welfare.

5. The technology of fissionable material production teaches that even a slight interruption in the manufacturing process may occasion great loss and damage to the entire operation. Government control is more likely to assure continuity of operation than is private control.*

Considerations of national defense and security were primary; these considerations were reinforced by the clear requirements of safeguarding the public health and safety and the anticipated adop-

* Seventy-ninth Congress, Second Session; Senate Report No. 1211 (Calendar No. 1251), Atomic Energy Act of 1946.

tion of a system of international controls of atomic energy. A law that merely prohibited the manufacture of atomic bombs by private interests would give no more assurance of effective operation at home than a bare pact to outlaw atomic weapons would give in the international field. Fortunately, fissionable material, as such, cannot be found in nature but is the end item of elaborate technical processes. State ownership of the facilities that perform these processes and of the fissionable material produced was deemed to be indispensable to an adequate control system.

One further consideration justifies monopolistic government control and helps to define its limits. The practical application of atomic energy was made possible through a government expenditure of almost 3 billion dollars. Production plants, laboratories, stockpiles of raw materials, technical experiments relating to the production of fissionable material, all were paid for out of the public purse. In view of these widely known facts it was difficult to challenge the proposition that what the people had paid for rightfully belonged to the people. "The benefits of atomic energy," said President Truman in his letter to Senator McMahon on atomic energy legislation, "are the heritage of the people; they should be distributed as widely as possible."

Private Activities in the Production of Fissionable Material

Driven by irrefragable logic to adopt the position of government monopoly of production and ownership of fissionable material, the legislative draftsmen were aware, nonetheless, that the main stream of atomic energy development would soon grow sluggish if it were dammed off from the source springs of private research and industrial enterprise.

Private Research Facilities

The Act provides that the Commission, as agent of and on behalf of the United States, shall be the exclusive owner of all facilities for the production of fissionable material "other than facilities . . .

which are useful in the conduct of research and development activities" in all fields of scientific investigation, pure and applied, relating to atomic energy. Such facilities must not "in the opinion of the Commission, have a potential production rate adequate to enable the operator of such facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon." Facilities meeting these requirements may, under Section 4(c)(3), be used to produce fissionable material in the conduct of research or development activities.

In short, researchers may own their own production facilities and may operate them to make fissionable material in the course of their work. The only restriction is that the equipment be of limited capacity. So we find the government monopoly relaxed to place research in a specially privileged category, the policy of freedom for research expressed in concrete terms. The restriction on size of research facilities should not embarrass research, since the amount of fissionable material produced in research laboratories, or necessary to the continuation of research, is not of the same order of magnitude as the quantity required for a bomb or for atomic power production. As it happens, however, the behavior of phenomena in the small extends, in this field, to the same phenomena vastly magnified. The gigantic extraction and purification facilities at Hanford, running to 350 million dollars in cost, were designed on the basis of research findings made with only half a milligram ($\frac{1}{2000}$ gram) of plutonium.

Broad discretion is vested in the Commission in its interpretation of the phrase "to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon." What is a sufficient quantity? The size of the bomb, *i.e.*, the critical mass, is a military secret and cannot be revealed in the Act. (It must lie, says the Smyth Report,* between one and one hundred kilograms.) What is a "reasonable

* Henry De Wolf Smyth. A general account of the development of methods of using atomic energy for military purposes under the auspices of the United States Government, 1940-1945 (United States Government Printing Office, Washington, 1945).

period of time"? This, presumably, is a secret only to those who are not lawyers, judges, or "reasonable men." Congress refused to assume the task that legal scholars and jurists have for centuries evaded and provided no definition of this phrase. Instead, it is fair to infer, it empowered the Commission to determine for each research laboratory whether its rate of production of fissionable material, conjointly considered with the nature of its facilities, justifies exemption from the general prohibition. In practice, the Commission may find it desirable to indicate advance approval of capacities large enough for most research but well below bomb-making capacity.

Management Contracts

Fissionable materials, except for small quantities produced in research, are manufactured presently at two large government centers—Oak Ridge, Tennessee, and Hanford, Washington. The Act directs the transfer of these facilities by the President to the Commission.* "The Commission is authorized and directed to produce or to provide for the production of fissionable material in its own facilities" [Section (4) (c) (2)].

During its tenure, the War Department, through its Manhattan Engineer District, provided for operation of these facilities by management contracts with several large industrial concerns—Du Pont, Tennessee Eastman, Allis-Chalmers, Union Carbide and Carbon, General Electric, Monsanto Chemical, Kellex, among them. The success of the project bespeaks the competence of their performances. Management fees were not excessive and in some cases—Du Pont, for example—merely nominal. But the fee, whatever its amount, was of course a relatively minor part of the inducement to enter into a management contract. Patriotic motives undoubtedly were strong, but there were also considerations of business and technical advantages—the opportunity to learn and develop a new art; the acquisition of invaluable technical and engineering experience and information; the establishment of a reputation as a pioneer in an industrial field limit-

* By Executive Order 9816, issued on December 31, 1946, the President transferred all properties of the War Department's Manhattan Engineer District to the Atomic Energy Commission.

less in its horizons; a first march on future competitors; the possibility of acquiring valuable patents as an outgrowth of research and development activities conducted at federal expense. These considerations in no way diminished the cordial cooperation of private industry with the Manhattan Engineer District.

The Act expressly recognizes the contribution that private industry must continue to make to the growth and development of atomic energy. The Commission is to own production facilities, but it may enter into management contracts for the conduct of all or part of the actual production operation. "To the extent deemed necessary," the Act provides, "the Commission is authorized to make, or to continue in effect, contracts with persons obligating them to produce fissionable material in facilities owned by the Commission." Clearly the continuity of operations essential to many phases of fissionable material production could not have been assured without some such provision. Thousands of workers, skilled, experienced, and proved, now operating the production facilities owned by the Commission, are under private management. The best-trained technicians who supervised the several stages of the complex, delicate, and often dangerous production processes are employed by private firms under government contract. The Commission can scarcely dispense with their services, nor can Congress assume that an adequate number of workers, engineers, and technicians would exchange private for government employment. Final decisions on every issue must lie with the Commission, but it was essential to allow the Commission to delegate to industrial concerns authority to conduct daily operations and exercise practical managerial control.*

What policy should the Commission adopt for management contracts? The Commission may itself produce or "provide for the production" of fissionable material in its own facilities. How shall the Commission be guided in its choice? The Act does not say and the Commission, doubtless, has wide freedom, but there are broad policy declarations that suggest Congressional preferences. Section

* Hanford, for example, is now operated, under contract, by the General Electric Company as successor to Du Pont. As part of the inducement to take on this managerial task, General Electric has a contract to erect a plant and laboratories at Knoll's Point, Schenectady, New York, to study the development of atomic power.

1(a), for example, provides that "the development . . . of atomic energy shall, so far as practicable, be directed toward . . . strengthening free competition in private enterprise." If this be anything but a perfunctory stereotype, it may be taken to mean at least two things:

First, wherever it can be accomplished safely and efficiently, government control plus private management is preferable to government ownership plus exclusive government management of production facilities. Progress in private industrial development of applications of atomic energy will certainly depend on the extent of industry's participation in the production of fissionable material. Second, the pattern set during the war must not serve as a matrix for the future. Opportunities to participate in production under government control must be extended to new industrial concerns, large and small, which for various reasons were not included in the several Manhattan District complexes. This conclusion is reinforced by national defense considerations, which dictate a wide distribution of technical knowledge as well as of industrial facilities. Finally, the Act directs the establishment of ". . . a program for government control of the production . . . of fissionable material . . . toward the broadest possible exploitation of the field" [Section 1(a)]. Expansion of the contractor group must, however, be limited to firms that are able to meet adequate standards of safety and efficiency.

Management contracts are subject under the Act to three express provisions:

1. Every management contract shall contain provisions "prohibiting the contractor with the Commission from subcontracting any part of the work he is obligated to perform under the contract, *except as authorized by the Commission.*"

In earlier versions of the McMahon-Douglas bill, management contracts for production were permitted but subcontracting was prohibited. Subcontracting raises security issues and practical problems of administration. Safeguards against unauthorized disclosure

of technical data about production processes are difficult to preserve in huge plants employing thousands, even where the facilities are few and concentrated in half a dozen locations. Enforcement of health and safety regulations is attended by similar problems. But if production facilities are widely scattered and involve the participation of hundreds of subcontractors having no direct responsibility to the Commission, the task of enforcing safeguards and regulations threatens to become impossible.

From the standpoint of practical administration and supervision of operations, apart from security and safety factors, an elaborate structure of contractors and their endless progeny of subs and sub-subs is so amorphous and unwieldy that to consider such groups under government control is dangerous self-deception. During the last war there were all too many instances of indiscriminate subcontracting by war procurement agencies, with a resulting waste of funds, serious interruptions to the war production program, defective products, delayed deliveries, and related abuses.

Doubtless the Commission holds these considerations in mind in exercising its discretion to permit subcontracting. In keeping with the emphasis of the language in the Act, it should be the exceptional practice justified by exceptional circumstances rather than the general rule.

2. Every management contract must contain provisions "obligating the contractor to make such reports to the Commission as it may deem appropriate with respect to his activities under the contract, to submit to frequent inspections by employees of the Commission of all such activities, and to comply with all safety and security regulations which may be prescribed by the Commission."

Powers to inspect and to require reports are manifestly essential for the Commission to enforce the provisions of the Act and its own regulations. The proper exercise of these powers should furnish the Commission comprehensive information concerning all significant scientific and technical developments in its sphere of interest. The Act is perhaps deficient in failing to provide expressly that subcontracts contain similar provisions. It is likely, however, that the

Commission's inspection rights extend to subcontractors under the established principle that the subcontractor is in no better position than his principal. In any event, the Commission could require the contractor to report on subcontractor activities. To effectuate the Act's clear purposes, the Commission should, as a supplementary precaution, include in its management contracts a stipulation that the contractor, in negotiating subcontracts, must require the subcontractor to agree to prepare reports and submit to inspection as the Commission may determine.

Throughout the Act there are exhortations and admonitions directed to the Commission "to strengthen free competition in private enterprise" [Section 1(a)]; to encourage "the entry of new, freely competitive enterprises" [Section 7(c)]; "to insure the broadest possible exploitation of the fields" [Section 1(b)]; to discourage the growth of monopoly [Section 7(c)]; etc. Exclusive access to technical information, more than any other single factor, would confer upon an industrial concern thus privileged a unique competitive advantage. For the Commission to foster or permit such a favored status would be to exhibit a flagrant disregard for the intent of Congress. Technical information on production processes and other phases of nuclear engineering obtained through reports and inspection must be made fully and freely available, subject only to procedures that insure security and safety. In addition to the monetary compensation they receive, participants in management contracts and subcontracts acquire invaluable experience and training for operating staffs. These advantages must be widely and equitably distributed and persons enjoying them should not be accorded further competitive advantage in the form of exclusive rights to technical data. This problem appears again in connection with patents and utilization devices.

3. "Any contract made under the provisions of this paragraph, may be made without regard to the provisions of Section 3709 of the Revised Statutes (U.S.C. Title 41, Sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is

not reasonably practicable, and partial and advance payments may be made under such contracts" [Section 4(c)2].

This provision is highly useful to the Commission in the interests of simple, efficient operation. Competitive bidding requirements, which exercise a salutary effect in many areas of federal activity, are inappropriate in this field. That is not to say that the Commission may simply eliminate the statute from consideration. But management contracts must be made on the basis of many factors—security, safety, experience, to mention a few of first importance—and the level of the bid, wherever the practice of bidding is at all admissible, should be considered only one element—and that not the most important—in awarding the contract. The authority of the Commission to make partial and advance payments enhances the feasibility of long-term and open-ended contracts that may prove advantageous in this experimental period and permits the utilization of smaller industrial concerns whose limited capital might not otherwise enable them to enter into an arrangement with the government.

Altogether, management contracts should be used by the Commission to promote both the immediate and long-range objectives of the Atomic Energy Act. The Commission has the sole responsibility for producing fissionable material and promoting advances in the technology of production. It has primary responsibility for research and development in fundamental and applied science. It has a broad and comprehensive responsibility for promoting and developing the useful applications of atomic energy. Its contractual relations with industry, therefore, must be considered as more than mere commercial arrangements, wherein the public interest is best served by favorable financial terms. Management contracts are instruments of social and economic policy. They must be regarded as part of a meaningful and coherent design covered by the Commission's major activities. They must be integrated with all its programs, serve as encouragement and incentive to free enterprise, and, above all, promote the rapid and widespread extension of the peaceful benefits of atomic energy.

Private Research with Commission Facilities

The Commission may produce fissionable material in its own facilities or authorize their operation by private contractors. Some industrial concerns, however, will not be interested in production contracts as such. They will wish to participate in large-scale research and development projects in order to gain technical knowledge and engineering experience in the atomic energy field. With this knowledge and experience they may enter, subject to license by the Commission, two major branches of manufacture—devices utilizing atomic energy as a propellant or substitute for coal, oil, electricity, etc., or facilities (machinery, equipment, devices, etc.) for the production of fissionable material.

For either type of manufacture, however, extensive research, experimentation, and the making and testing of models are clearly prerequisite. Such activities are likely to be costly and risky, particularly during the present primitive state of the science, and even when successful, profits may be long deferred. A further hazard to private enterprise lies in the possibility that a given project may run afoul of the prohibition of private research activities in which fissionable material is produced at a rate sufficient to make atomic weapons. Experimental power plants driven by atomic energy would be particularly subject to this hazard, since such plants are likely to produce fissionable material in sizable quantities.

Under these circumstances a reluctance on the part of private firms to embark upon research and development programs would be understandable. It was recognized by the legislative draftsmen, however, that the cooperation of private industry in the field of research and development—particularly as regards practical applications—is essential to vigorous and progressive development. Accordingly a provision was incorporated in the Act designed to remove these difficulties. Section 4(c)(2) provides: "The Commission is also authorized to enter into research and development contracts authorizing the contractor to produce fissionable material in facilities owned by the Commission to the extent that the production of such fissionable material may be incident to the conduct of research and

development activities under such contracts." Contracts under this provision are subject to the other provisions applicable to management contracts, which have been discussed above.

Production outside the United States

"Persons" under the jurisdiction of the United States are prohibited from engaging, *directly* or *indirectly*, in the production of fissionable material outside the United States. The control is designed to prevent individuals from circumventing domestic prohibitions through the device of establishing production facilities abroad. Direct participation is perhaps easily definable; but what is "indirect" participation? No simple formula is available. The plain intent of Congress was to prohibit ownership of facilities on foreign soil, contractual participation in the financing or operation of such facilities, and personal participation, as an employee or otherwise, in such production operations. Attempts to evade domestic controls by entering into cartel arrangements would be patently illegal. But would a "person," as the term is used, be prohibited from owning stock in a foreign corporation producing fissionable material? Would a loan to such a corporation be forbidden? What of a gift? Such questions may raise few practical issues, but until the language of the Act has been tested in practice and in the courts, it is difficult to judge whether the net of control has been woven finely enough to prevent deliberate evasions and abuses.

The Manufacture of Production Facilities

The Atomic Energy Act comprises an extensive list of prohibitions, limitations, and restraints. As already pointed out, they were incorporated in the Act because it was reluctantly conceded that they were indispensable to the achievement of national security, health, and safety. The effort was made in every case to apply the minimum repressive measures consistent with this objective. Fissionable material is monopolized, but source material is less stringently controlled by a flexible licensing system. Production of fissionable material in substantial quantities is only permitted in state-owned

facilities, but as an incident to research and development it is, with few restrictions, permitted in private facilities.

Applying the same criteria to the manufacture of production facilities, the draftsmen of the Act decided that a relatively mild control by licensing would be adequate [Section 4(e)]: "Unless authorized by a license issued by the Commission, no person may manufacture, produce, transfer, or acquire any facilities for the production of fissionable material."

What are "facilities for the production of fissionable material"? A definition is given in Section 18(g): "The term . . . shall be construed to mean any equipment or device capable of such production and any important component part especially designed for such equipment or devices, as determined by the Commission." It is doubtful that this vague compendium affords the Commission a particularly precise or useful standard in deciding the concrete cases that confront it. The Commission must act as lexicographer and judge. This result cannot be altogether satisfactory for the manufacturer, especially one who has many products, since he will find it necessary to seek a ruling from the Commission in every case.

However, enumeration of all facilities, even by categories, would have been manifestly impossible. For one thing, the bulk of production technology is still regarded as subject to security safeguards; it is, in other words, "restricted data," as the term is used in Section 10 of the Act. For another, many component parts that go into the varied and complex production processes are revolutionary in design and their value for other, nonatomic, purposes is not known. It is possible that experience will prove that some of these components have even greater value outside the field of atomic energy than in it. No doubt many such components will be released for free use by the Commission after it has determined that they do not have a unique relation to fissionable material production. It will be possible to accomplish this end either by granting automatic licenses or by exclusion from the definition. Component parts of dual function, *i.e.*, useful both for the production of fissionable materials and for other industrial ends, should be controlled, except in most unusual cases, only as to their use in connection with atomic

energy; normal industrial use should be unrestricted. The Commission faces similar dilemmas in the discharge of its patent functions, as we shall see.

In issuing licenses the Commission has broad, flexible authority [Section 4(e)]: "Licenses shall be issued in accordance with such procedures as the Commission may by regulation establish and shall be issued in accordance with such standards and upon such conditions as will restrict the production and distribution of such facilities to effectuate the policies and purposes of this Act." As always, safety and security factors will take first place in their determinations. A device of unique design, particularly ingenious, may be licensed for transfer only to the Commission's production plants, even though it has other industrial uses. The evident purpose would be to preserve our present advantage in the atomic energy field and, equally important, to prevent specimens from falling into unscrupulous hands. Licenses might specify and restrict the uses to which a facility could be put. In the licensing and patent powers, the Commission has effective instruments with which to prevent the development of monopolistic practices in the manufacture of production facilities.

While the export of production facilities is not explicitly prohibited, the legislative history of the Act, as well as the spirit in which it was framed, would indicate that the granting of export licenses would contravene the intention of Congress. This is not to say, of course, that export might not be justified by circumstances, but the Commission would be well advised to clear any such proposed action with the President and with the Joint Congressional Committee on Atomic Energy. See recent regulation issued by Commission.

Research is given its usual privileged position. "Nothing in this section shall be deemed to require a license for such manufacture, production, transfer, or acquisition incident to or for the conduct of research or development activities in the United States of the types specified in Section 3" * [Section 4(e)].

Certain production facilities may have been manufactured or acquired by private individuals during the war in connection with

* See Chap. 10.

contracts with the Manhattan District. Since the licensing requirement is not retroactive and does not prohibit use of such facilities, they may continue to be used in any way that does not contravene other provisions of the Act—*e.g.*, for normal industrial purposes or for the production of fissionable material in research.

Finally, the Commission is itself expressly authorized to manufacture production facilities for its own use [Section 4(e)]. This authority, analogous to that of the Navy Department to operate its own shipyards, may prove useful in connection with the operation of large, integrated, government-owned production facilities and more particularly in connection with highly specialized facilities requiring extraordinary security precautions.

Ownership of Fissionable Material

"All right, title, and interest within or under the jurisdiction of the United States, in or to any fissionable material, now or hereafter produced, shall be the property of the Commission, and shall be deemed to be vested in the Commission by virtue of this Act" [Section 5(a)(2)]. No provision of the Act is more direct or sweeping. But its interpretation as to consequences and its implementation are not without difficulties.

At first glance it might appear impossible, by legislative fiat, to eliminate private ownership of substances, the sources of which are to be found almost everywhere in the earth's crust. But as already noted, the problem has "definable boundaries" and can be reduced to an area that we can hope to control. For control purposes only fissionable material artificially produced requires attention. The traces of fissionable material distributed in minute quantities throughout the earth's crust can be safely disregarded and attention centered on U-235, plutonium, thorium, protoactinium, and other fissionable substances "as the Commission may determine." It is to be hoped, in the interest of our common survival, that the Commission will not be called on either early or often to make additional determinations.

Fissionable material in quantities of military significance must,

for obvious reasons, be owned by the state. Such ownership complements state ownership of production plants. But, since private ownership of small facilities that produce small quantities of fissionable material in the course of research and development is permitted, why, it may be asked, should private ownership of small quantities of fissionable material be prohibited?

The restriction, like others in the Act, is based on a calculation of safety and security requirements. Even a small research production plant must be a fairly substantial installation, difficult to conceal, impossible to move on short notice. It may be inspected, its capacity evaluated, the distribution of its end product controlled. The hazards of its operation can be reduced substantially by enforcement of appropriate safety regulations. But fissionable material, even in minute quantities, is dangerous to health, and while the critical mass required to achieve an explosion is substantial, the possessors of small amounts, if bent on mischief, might pool their supplies and assemble a bomb of enormous destructive power.

Apart from security and safety factors, there are compelling reasons for vesting title to all fissionable material in the state. These substances, of such enormous economic and military importance, are comparatively scarce and require vast expenditures of resources to produce. They embody, even in small quantities, so vast a potential for good or evil that property rights in them can be entrusted to no entity less inclusive than the state, which acts as trustee for all the people. The nations of the world must soon decide whether, in view of the bodeful portent of these materials, the state itself is a custodian sufficiently inclusive in its representation of the interests at stake.

Though only the government may own fissionable material, private research organizations may, as we have seen, produce small quantities in their own facilities. These materials under the Act automatically become the property of the Commission. To meet due process requirements, the Act provides: "Any person . . . who lawfully produces any fissionable material incident to privately financed research or development activities, shall be paid just compensation therefor." It may be noted that no compensation is pro-

vided for material produced in private research under government contract, thus assuring no extra payment for material so produced. For research conducted partly with private and partly with federal funds, the Act appears to permit "just compensation" to be paid, although such payments seem inferentially at least to be discouraged. Just compensation is also provided for fissionable material that was privately owned when the Act became effective or that was first declared a "fissionable material" at some later time.

Control over fissionable material is strengthened by two further provisions. The first [Section 5(a)(3)] makes unlawful, after sixty days from the effective date of the Act, the *transfer* as well as possession of fissionable material, "except as authorized by the Commission." Also forbidden is the "export from or import into the United States" of any fissionable material. The reason for the prohibition of exports is self-evident. Imports, to begin with, are not likely. Moreover, fissionable material is scarcely a suitable commodity for the import trade, since the importer is prohibited from either possessing or transferring it once it is within the jurisdiction of the United States. But it should be noted that the prohibition runs to "persons," that the Commission "or officers or employees of the Commission in the exercise of duly authorized functions" are not subsumed under this definition, and that this group, therefore, may engage in the import of fissionable material should this policy be adopted. Permission is made explicit in the provision next described.

Sweeping authority is given the Commission [Section 5(a)(5)] "to purchase or otherwise acquire any fissionable material or any interest therein outside the United States." * The Commission is also empowered to purchase, or otherwise acquire, "any interest in facilities for the production of fissionable material, or in real property on which such facilities are located. . . ." There is exemption, as elsewhere, from the competitive bidding statutes upon certification by the Commission that its actions are in the interest "of the common defense and security, or upon a showing that advertising is not reasonably practicable." † Provision is made for partial and ad-

* See p. 271.

† These provisions are also considered in Chap. 13.

vance payments. Finally, the Commission is authorized "to take, requisition, or condemn, or otherwise acquire any interest in such facilities or real property," making just compensation * [Section 5(a)(5)].

Distribution of Fissionable Material

Policy Considerations

Realization of the benefits of atomic energy requires, as we have said, that fissionable material be put to work. Ownership by the Commission is not an end in itself. Thus, we face the question, under what circumstances shall private possession, as distinguished from ownership, of fissionable material be permitted? The Act links possession with its policies on distribution of fissionable material, and it will be convenient to consider these features jointly.

The science of nuclear energy both in its pure and applied aspects is in an elementary stage; aside from military uses, there has been little more than speculation about the practical applications of the discovery. What is needed to speed development in this field is vigorous, sustained, widespread research by all competent scientists. But this means that fissionable material must be made available to such scientists either directly through government grant (on loan) or indirectly by permitting research laboratories to retain for their own experiments and investigation the fissionable material that they themselves have produced. Similarly, unless the Commission operates all of the many devices embodying applications of atomic energy that will undoubtedly be developed, fissionable material must be made available to private enterprise for such use. The Act provides [Section 5(a)(4)]: "Without prejudice to its continued ownership thereof, the Commission is authorized to distribute fissionable material owned by it, with or without charge, to applicants requesting such material (A) for the conduct of research or development activities, either independently or under contract or other arrangement with the Commission (B) for use in medical therapy, or (C) for use

* These provisions are also considered in Chap. 13.

pursuant to a license issued under the authority of Section 7." (Category C will be considered in Chapter 7.) Research is again given a favored position by the Commission's being not merely authorized but "*directed*" to distribute fissionable material "to permit the conduct of widespread independent research and development activity, to the maximum extent practicable."

Material Produced in Research

Fissionable material initially produced incident to independent research and development activities may be retained for further research and experimental work, for medical therapy, or for industrial use pursuant to license. Possession may thus be regarded, by those who are legalistically inclined, as a kind of "constructive distribution." Or to put it differently, if one who has produced fissionable material incident to legitimate research desires to retain it, his request will be considered on the same basis and by the same standards as if he had applied to the Commission without having produced any fissionable material. If the Commission "distributes" the material to him, he may use it without ever having surrendered physical possession.

"Safe" Quantities

In distributing fissionable material, the Commission is required to give primary consideration to the security factor. "Such material shall be distributed in such quantities and on such terms that no applicant will be enabled to obtain an amount sufficient to construct a bomb or other military weapon."

Fortunately, this limitation will not hamper research. Almost all laboratory and experimental work, even some pilot-model development activities, do not require militarily significant quantities. Where larger amounts are needed the Act, as has been mentioned, provides for research contracts involving the use of the Commission's facilities and, as an incident to these contracts, the Commission may allot fissionable material at its discretion. Medical therapy, certainly on the basis of experience with radium, will require only small quantities. Furthermore, most medical requirements can be

satisfied by the use of irradiated substances—*i.e.*, elements made radioactive by exposure to radiation emanating from piles or by means of other processes—and fissionable material will not be needed. This point will be further discussed in Chapter 6, but it may be noted here that Section 4(d) authorizes the Commission "and persons lawfully producing or utilizing fissionable material . . . to expose materials of any kind to the radiation incident to the processes of producing or utilizing fissionable material" for the purpose of increasing the supply of radioisotopes.

So far as other peacetime uses of atomic energy are concerned, their development is not likely to suffer unduly as a result of quantity limitations on distribution. This is certainly true at the present stage when practical applications have not been perfected; later, if discoveries should alter requirements, Congress, on recommendation of the Commission, may decide to amend the Act accordingly. Further discussion of devices utilizing atomic energy may be found in Chapter 7.

Conservation

The Commission, of course, must husband resources in order to provide adequately for its own needs and generally, in its distribution policy, assure such conservation of fissionable material "as it may determine to be necessary in the national interest for the future development of atomic energy" [Section 5(a)(4)]. This includes the major responsibility of stockpiling, pursuant presumably to presidential directive, for military purposes.*

The Commission may decide to withhold fissionable material from distribution for another reason as well. It may find that certain techniques of production that promise to augment considerably the total output of fissionable material will involve the utilization of quantities of fissionable material in the production process. It is known that various types of reactors † for making plutonium from metallic uranium may utilize quantities of fissionable material as

* The general stockpiling powers of the Commission and their relation to the stockpiling authority established in the Strategic Materials Stockpiling Act of 1946 are discussed in Chap. 5.

† A more general term than "pile."

an auxiliary substance. Details of this method are still tight under the clamp of secrecy, but it has been stated that the new technique may permit smaller and less costly production facilities.* While some quantity of fissionable material is consumed, presumably the process yields a net gain. If these reports are valid and the Commission decides to construct new facilities of this type, it may be necessary to build up a stockpile of fissionable material to get the facilities under way.

Two further reasons for stockpiling may suggest themselves to the Commission. While some atomic energy processes, such as generation of power, result in the creation of new fissionable material, many peacetime uses that may be licensed under the Act will not have that result. To assure not only an initial spurt of activity but also continuity in the operation of atomic energy devices the Commission may deem it desirable to build up advance stockpiles. This is a matter of timing and of judging the value of immediate as compared with deferred activities. The same kind of problem arises in deciding between research and other needs, between providing for current research requirements and those that may be expected to arise after new avenues have been opened. With supplies of fissionable material essentially limited the Commission is likely to find itself in the painful position of a hen whose wingspread simply cannot be made to cover her pullulating brood.

Safety Standards

Section 12(a)(2) authorizes the Commission to "establish by regulation or order such standards and instructions to govern the possession and use of fissionable . . . materials as the Commission may deem necessary or desirable to protect health or to minimize danger from explosions and other hazards to life or property." This authority is reinforced, with respect to the distribution of fissionable material, by the express direction that the Commission withhold or withdraw material from any applicant who does not "observe such safety standards to protect health and to minimize danger from explosion or other hazard to life or property as may be established

* See p. 347, Appendix C.

by the Commission . . ." [Section 5(a)(4)]. This power to withhold or withdraw is extended to any applicant who uses such material "in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor" [Section 5(a)(4)].

Prohibitions on Allocation

Reinforcing the export prohibition, the Act directs the Commission not to distribute fissionable material to "any person for a use which is not under or within the jurisdiction of the United States," or to any foreign government.

Distribution to any person within the United States that "would be inimical to the common defense and security" is also prohibited. Applied with intelligence, this limitation will bring about no change in the Commission's exercise of its discretion in allocating fissionable material. The very vagueness of the standard, however, offers an opportunity for discrimination that may bear watching. The Commission will probably find it necessary to invoke this reason for refusal only in the rare case where some direct threat to the nation's security is involved.

5. Source Material

> Be thou on earth as Jove is in the sky,
> Lord and commander of these elements.
>
> Christopher Marlowe, *The Tragical History of Dr. Faustus,* Scene 1.

When Harlow Shapley appeared before the Senate Special Committee, he startled its members by placing a commonplace-looking rock on the table before him and announcing that it contained millions of atoms of uranium. He had picked up this rock in a Washington park on his way to the hearing and almost any other rock would have served his purpose equally well. For traces of uranium are literally everywhere; natural uranium occurs in approximately four parts per million throughout the earth's crust.

Although uranium is the principal source of fissionable material, the presence of traces of the element in Dr. Shapley's rock had no more significance for the large-scale release of atomic energy than the potential ability of the same rock to yield alumina would have had for the aluminum industry fifty years ago. As already indicated in Chapter 3, at least three major steps are required before atomic energy can ultimately be won from uranium-containing ores. First, the ore must be processed and uranium metal secured, a purpose for which only ores relatively rich in uranium content are suitable. Second, the uranium must be further processed to extract the fissionable isotope U-235 or to convert the U-238 into the fissionable material, plutonium. And finally, the fissionable material must undergo further treatment before atomic energy can be released. The report of the Senate Special Committee indicates graphically the relation of source material to atomic energy:

Source material + processing → fissionable material

Fissionable material + processing → atomic (*i.e.,* nuclear) energy

Inadequacy of Data

The pitfalls of legislating without benefit of essential information, alluded to in an earlier chapter, surrounded the legislators on all sides as they framed the provisions of the Act relating to source material. Published reports on the subject were meager, and the Senate Committee was able to elicit no significant data concerning techniques of mining, refining, or locating source material, quantities of material required to produce fissionable material, resources within the United States, or supplies available from abroad.

An impenetrable curtain of secrecy fell upon such matters early in 1943, at which time the mere mention of the word uranium became taboo. The last information we have appears as a blazing indiscretion in the sober official pages of the Minerals Year Book for 1943, published by the Department of the Interior.

This respectable organ, after stating that restrictions on the use of uranium had been applied for the first time in January, 1943, and that in the interest of secrecy the War Production Board had relinquished to the War Department the supervision of supply and distribution, went on to state flat-footedly, "The principal peacetime outlet for uranium is as a colorant in ceramics, but this use was prohibited in January, 1943, to assure ample supplies for research on uranium isotope 235 as a source of energy."

Since this shattering pronouncement, which in retrospect does not appear particularly to have profited the Germans or Japanese, all has been silence.

It can be said that Congress shares in full measure the popular ignorance and that the Act was drawn up without the benefit of adequate information on many of the major points. The representatives of the Manhattan Engineer District maintained a mute and inscrutable reserve in the face of the prying attempts of the Special Committee to elicit information, and in the end the Senators desisted. Take the data available to the legislators on the subject of arrangements to acquire uranium from foreign sources. They had the same knowledge as the public that uranium is imported from

the Belgian Congo and Canada, but the extent of our dependence on these sources and any details concerning contracts for future deliveries remained shrouded in secrecy. To be sure, Secretary Stimson issued the reassuring statement that we had contracts with the principal producers that would safeguard our supplies. But what form these contracts take, what supplies they guarantee (either absolutely or in relation to requirements), what use they would be in the event of political difficulties with the supplying countries was never in any part revealed.

The provision of the Act relating to source material was compounded of enigmas such as this. The assumptions underlying this provision may by felicitous coincidence be correct, but it is possible, too, they may be altogether wrong. At any rate, no expert in the field pointed out any defects in the provision, and the War Department officially approved the bill. Whether this indicates that the assumptions were substantially correct or that the custodians of the secret held the passage of a faulty Act a lesser evil than disclosure of information, we cannot presume to say.

Definition

In the strict sense, in the present state of the science, source material would include (1) the ores from which uranium and thorium metal are extracted and (2) uranium and thorium at any stage in their processing prior to their enrichment by increasing the proportion of U-235, by converting U-238 into plutonium, or by converting thorium into U-233.

In defining the term in the Act, however, a considerably broader definition of "source material" was used. The term was stated to include "uranium, thorium, *or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials;* . . . [and including] ores . . . if they contain one or more of the foregoing materials in such concentration as the Commission may by regulation determine from time to time." [Section 5(b)(1), italics by authors.]

As primary substances the definition specifies uranium and thorium. Neither element is to be found in nature in significant quantities as a pure metal. Both occur in geological deposits as chemical compounds associated with other minerals—uranium usually as an oxide. As a constituent of the ore in which it is found, uranium oxide may run from a small trace (kochelite contains about 1 per cent uranium oxide) to almost 90 per cent (pitchblende). Deposits moderately rich in uranium content have been found in the United States, but the largest and richest known deposits are located in the Belgian Congo, Canada, and Czechoslovakia.

In recognition of the fact that not all ores containing uranium or thorium are of significance to the problem of controlling atomic energy, the Commission is authorized to establish the concentration of source material that ores must contain in order to make them liable to the controls of the Act.* For each source material a finding will have to be made based on such considerations as the technological factors involved, the economics of mining and refining, conservation requirements, etc. These findings are, of course, subject to change in keeping with changes in technology, advances in scientific knowledge, and other pertinent circumstances. The device of leaving this decision to the Commission served not only to provide flexibility with which to meet scientific developments; it was useful as well in avoiding disclosure of much of the technical information on ores, refining, and prospecting that is still classified.

Going beyond uranium and thorium and the ores from which they are derived, the definition also includes "any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable material." This amplifying clause was made a part of the definition to enable the Commission to bring under its control not only materials that might later prove to be useful but also some whose value had already been proved. It should be noted that the phrase "ma-

* By regulations issued March 17, 1947, the Commission (Sec. 40.2) has defined source material as "any material, except fissionable material, which contains by weight one-twentieth of 1 per cent (0.05 per cent) or more of (1) uranium, (2) thorium, or (3) any combination thereof." See Appendix H for the full text of these regulations.

terials . . . peculiarly essential to the production of fissionable material" is not limited to the substances that are made fissionable by processing. Used in this broader sense, "source materials" need not themselves be capable of being made fissionable; it is sufficient if they perform some other vital role in the production process. Strictly speaking, such materials would be no more a source of fissionable material than a midwife is parent to the child whose birth she attends. However, legislative draftsmen are no respecters of the niceties of established literary usage. When these stand in the way of convenience, they adopt the philosophy of Humpty Dumpty, who insisted that words had to mean what he wanted them to mean. The draftsmen of the McMahon-Douglas bill wished to make it possible for the Commission to control any material needed in the productive process. Accordingly, instead of adding an additional category of say "ancillary materials," they engaged in some semantic juggling and brought these materials under the definition of source material. Among the substances that the Commission may decide to subject to this philological violence are certain auxiliary materials that are in such scarce supply that they must be carefully conserved. Beryllium may be cited as an example of such a material. This metal, which has unique properties as a neutron absorber, is used in the rods that control the chain reaction in the pile and does not become fissionable at any stage. No effort is made in the Act to list these materials for the same reasons mentioned above in connection with ore concentrates—that is, security considerations and uncertainty as to the effects of technological developments.

The mere fact that a particular substance is required for the production of fissionable material does not necessarily mean that it should be brought within the definition of "peculiarly essential." If a substance is in abundant supply, there is clearly no need for such classification. Even when a required material that has important industrial applications is not in abundant supply, resort to the licensing device, as a rule, should not be necessary. Take the case of lead. This material is used in the production of fissionable material as shielding in a pile to guard against dangerous radiations

and may be termed "essential" to the process; furthermore, it will probably be in short supply for years to come. The mere existence of the power possessed by the Commission, with the President's approval, to declare lead a source material and subject it to licensing, condemnation proceedings, etc., would undoubtedly be sufficient to assure the zealous cooperation of producers in meeting the modest requirements of the atomic energy program.

The approval of the President is required to make materials other than uranium and thorium subject to the source material controls of the Act. Since positive actions by the Commission under this clause may have a severe impact on industries outside the field of atomic energy and possibly on the nation's economy, this provision is clearly necessary. It will be the duty of the President to weigh the importance of the material to the atomic energy program against the possible adverse effects of the Commission's action upon general industrial activity and the welfare of the country as a whole and to approve or disapprove according to his judgment of the balance of factors.

Elements of the Control System

Even though knowledge of requirements and supplies of source material was lacking, certain objectives of the control system were apparent. It was clearly necessary to assure the Commission priority in meeting its needs and to prevent dissipation of available resources; to encourage discovery and development of new sources of supply; and to provide against possible interruptions in the productive process resulting from temporary shortages of source material.

The system designed to accomplish these objectives includes these major elements: a licensing system, condemnation powers, provisions for the encouragement of prospecting, and special provisions governing the exploitation of deposits of source material in public lands. These are considered in order.

The Licensing System

Although source material is strategic raw material of high national importance, it is not fissionable and not dangerous *per se;* consequently, it does not require the same degree of control as fissionable substances. As with equipment or facilities for the production of fissionable material, source material can be adequately controlled by a licensing system designed to regulate its movement, transfer, and possession. "Unless authorized by a license issued by the Commission, no person may transfer or deliver, receive possession of or title to . . . any source material *after removal from its place of deposit in nature. . . .*" [Section 5(b)(2), italics by authors.] Among the first objectives of this provision is the prevention of diversion of source material to illegal and clandestine uses such as the private production of fissionable material. If source material is under surveillance from the moment of removal from its place of origin, an extensive bootleg traffic is manifestly impossible. In this connection it should be recalled that comparatively large amounts of source material are required to produce fissionable material. Thus, if small amounts were illegally diverted, the matter would be of no significance for the national security.

Consider some of the implications of this provision. Source material may be privately owned. Real property bearing deposits of source material may be freely sold or otherwise legally conveyed. Mining operations may be conducted free of license; they are uncontrolled until the point at which source materials become extracted minerals.

Mere removal of a source material from its place of deposit in nature, however, brings the licensing system into play. From the moment of removal, any traffic in source material must be authorized by license. Thus, transporting ore (of sufficient concentration to be "source material") from the mine to refining, smelting, and other industrial plants requires a license. A license must be obtained for transfer of title to source material, whether or not the physical location is affected by the legal transaction, as well as for any move-

ment or change in physical location, even if the title is unaffected. A person transferring his own or consigned source material from one of his plants or places of business to another would require licensing authority for the transfer. In practice, such movements may be facilitated by issuing licenses that authorize an owner or possessor of source material to move it about freely in the normal course of his business as long as he retains legal title or possession. Change in title or transfer of possession might require an additional license.

Export of source material is not prohibited but is made subject to license. As a general precaution and in keeping with its primary concern over the safeguarding of national security, Congress provided that no licenses shall be issued to any person if, "in the opinion of the Commission, the issuance of a license . . . would be inimical to the common defense and security" [Section 5(d)(2)]. As indicated in the preceding chapter, it is essential that this provision be applied only on the basis of incontestable evidence and not as justification for arbitrary or discriminatory practices.

Perhaps the clearest admission that Congress constructed the source material section without benefit of knowledge of all the relevant facts can be found in the standards governing the Commission's operation of the licensing system. "The Commission shall establish such standards for the issuance, refusal or revocation of licenses as it may deem necessary to assure adequate source materials for production, research or development activities pursuant to this Act or to prevent the use of such materials in a manner inconsistent with the national welfare" [Section 5(b)(3)]. This statement of objectives is coupled with no hint of necessary measures, nor is there any indication of standards or procedures to be followed by the Commission in performing its licensing functions. "Licenses shall be issued in accordance with such procedures as the Commission may by regulation establish." This sentence authorizes varying licensing techniques ranging from automatic, general, or blanket licenses for uses and quantities that may be held to be unimportant

to the objectives of the Act to the imposition of the most exacting standards where these seem to be required.

Altogether, the licensing system enables the Commission to exercise complete control over source material from the moment the ores are removed from their original place in nature until they become fissionable material or are consumed in the course of research or industrial use. In point of fact, as will appear from the discussion below, the bulk of our uranium requirements, both before and after the winning of atomic energy, was supplied by imports, and indications are that this is likely to continue to be the case. It appears that our requirements of thorium will probably be met from imports also. The Commission itself would be the importer of most of these materials. Private importers would have to obtain licenses from the Commission that would no doubt be substantially the same as those of the WPB Import Order M-63 with which importers became thoroughly familiar during the war.

The effect of the licensing system on industrial uses of these elements cannot now be determined. Prewar, nonatomic energy uses were not extensive. Uranium was used as a coloring agent for ceramics and glass, in amber signal lenses, and in glass with a special coefficient of expansion for glass-to-metals contact in radio tubes. Thorium was consumed principally in the manufacture of gas mantles. Whether these activities will be permitted to continue, and, if so, to what extent, must depend upon the supplies available and the requirements of the Commission, neither of which has been disclosed. If the material can be spared, the Act offers a ready means of permitting small-scale uses. It provides that licenses "shall not be required for quantities of source materials which, in the opinion of the Commission, are unimportant" * [Section 5(b) (2)].

To assure the Commission of the information needed to run its licensing system, the Act provides that the Commission is authorized "to issue such regulations or orders requiring reports of ownership, possession, extraction, refining, shipment or other handling of source materials as it may deem necessary. . . ." [Section

* See regulations, Appendix H, Secs. 40.2, 40.10, 40.11, 40.29, 40.60, 40.61, 40.62.

5(b) (4)]. The Commission may waive the reporting procedure with respect to quantities of source materials which, in its opinion, are unimportant or "the reporting of which will discourage independent prospecting for new deposits" * [Section 5(b) (4)].

Direct Purchase and Condemnation

The Commission is authorized "to purchase, take, requisition, condemn, or otherwise acquire, supplies of source materials or any interest in real property containing deposits of source materials to the extent it deems necessary to effectuate the provisions of [the] . . . Act" [Section 5(b) (5)].

The Commission is not likely to have recourse to the power of condemnation unless forced to by exceptional circumstances. In general, private ownership of source material and of the lands containing deposits of such material should in no way conflict with the objectives of the Act. So long as there is no conflict, the Commission would have no object in interfering with private property rights.

It is possible, however, to conceive of situations that would justify the exercise of these powers—*e.g.*, repeated abuse or violation of the Commission's regulations or an unwillingness on the part of private owners to supply the Commission the quantities of materials necessary to efficient conduct of its operations. Although the mere existence of the power and the threat of its use should in normal circumstances be sufficient to enable the Commission to accomplish its purposes, a fundamental change in the international situation might require exercise of the condemnation power on an extensive scale. The threat of war and the necessity for a large and rapid expansion of mining and production might necessitate government control of such operations. On the other hand, the adoption of an international agreement of the type proposed in the Acheson-Lilienthal report would require a considerable extension of present controls over source material and, as a minimum, the placing of lands bearing deposits of source material under lease to the international

* See regulations, Appendix H, Sec. 40.30.

authority. Property requisitioned or condemned under this section must be paid for by the Commission.

A further provision, similar to the ones encountered in other sections, authorizes the Commission to make purchases of source material or real property without regard to existing advertising and competitive bidding statutes "upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable. . . ." Partial and advance payments may also be made in connection with such transactions.

The Commission is empowered to acquire source material "to effectuate the purposes of the Act"—the paramount purpose, according to Section 1, being that of "assuring the common defense and security." Nine days before the Atomic Energy Act was approved the President signed the Strategic and Critical Materials Stockpiling Act, in which the Secretary of War, the Secretary of the Navy, and the Secretary of the Interior, acting jointly through the Army-Navy Munitions Board, are authorized to determine which materials are strategic and the quantities of such materials that should be stockpiled.

The possibility that the stockpiling functions of the Commission with respect to source material and of the Secretaries of War, Navy, and Interior, acting jointly through the Army-Navy Munitions Board, with respect to all materials would have to be adjusted escaped the attention of Congress. Since there was no consideration of this point either in Committee or on the floor of either House, there is no point in attempting to determine the purpose of Congress. The logic of the situation, however, is clear. The Commission alone will have the knowledge of operating plans and material requirements on which stockpile estimates must be based. It will have the established commercial contacts both here and abroad. It has the power to fix prices and to license imports, to requisition and to condemn. In view of these facts it is clear that any effort by the Army-Navy Munitions Board to acquire uranium or thorium for stockpiling purposes would lead to utter confusion. The power

of the Commission to acquire source materials must be complete and exclusive.

The Commission's authority to require reports with respect to source material, mentioned in discussing the licensing system, is relevant to its purchase and eminent domain powers as well. Current and accurate information as to the location of supplies is essential to efforts to acquire them. In one important respect, however, the report requirement is inadequate. Reports may not be required of any source material "prior to removal from its place of deposit in nature." How this limitation impairs the effective use of purchase and condemnation powers is considered in some detail in the discussion of mining activities that follows.

Assuring Adequate Supplies

Accustomed to take for granted the fact that their country is bountifully blessed in all important resources, most Americans are apparently not aware that in deposits of source material the United States is only moderately well off. Indeed, our chief sources of uranium supply during the war were the mines of Canada and the Belgian Congo; these deposits, together with those in Czechoslovakia, are known to be richer than our own. As for thorium, present evidence is that the United States is at least equally deficient in commercial supplies.

Available estimates of the reserves of uranium in the United States are exceedingly vague. We know that commercial quantities of uranium have been found in the United States in two minerals—carnotite and pitchblende. We know that our reserves of pitchblende are negligible and widely scattered in small deposits. We know that we have appreciable supplies of carnotite, a mineral in which uranium is found associated with vanadium, and that the uranium oxide content of this mineral is about 50 per cent. And this is not far from the sum of our knowledge.

There are apparently no quantitative estimates of the extent of carnotite deposits in this country. We are variously informed that carnotite is widely distributed in the sandstone region of south-

western Colorado and southeastern Utah * and that these deposits are "great" and "extensive." At a time when the chief commercial use of uranium was as a coloring agent in ceramics, its demand limited, and its price fixed by the relatively low operating costs in the great pitchblende deposits of Canada and the Belgian Congo, there was no strong inducement to compile more complete data.

No doubt, more precise inventories have been prepared since 1942 but, as already indicated, this information is not available. Nor do we know the size of our imports, the nature of our supply arrangements, or the scope of our requirements.

Lacking these essential data, Congress sought to frame effective measures for meeting the Commission's source material needs. Congress assumed it would be desirable to encourage *prospecting and exploration* for source material in order to develop as complete an inventory of our resources as possible. This assumption is certainly valid. But the Act joins this desideratum with the assumption that intensified mining of domestic source material is also clearly desirable—an assumption that may not be valid at all.

The Commission is empowered in Section 5(b)(5) to "establish guaranteed prices for all source materials delivered to it within a specified time." As a device for encouraging production, this subsidy payment plan should be effective. In some circumstances it may be desirable to employ differential payments patterned on the wartime Premium Price Plan for copper, lead, and zinc. Under this plan higher prices were paid for the mining of lower grade ores or for the production of quantities in excess of a quota so fixed as to take into account operating costs in each mine. Even though in general the Commission will probably utilize domestic sources only to the extent necessary to supplement imports, there may well be occasions short of a national emergency when maximum production will be desirable—*e.g.*, the initial building up of a stockpile to meet defense requirements and to assure continuous supplies for a planned program of expansion in industrial applications of atomic energy.

The Commission's power to engage directly in mining activities

* Jack De Ment and H. C. Dake, *Uranium and Atomic Power* (Chemical Publishing Company, Brooklyn, New York, 1945), p. 28.

merits brief mention. The Act does not expressly authorize such activities but it does authorize the Commission to purchase or condemn real property containing deposits of source material and to "otherwise acquire" supplies of source material. With respect to possible mining operations to be performed by the Commission, the Senate Special Committee report states that it was not intended that the Commission should "engage in mining operations in competition with private mining activity unless such operations are necessary to insure to the Commission a supply of source materials adequate for carrying out its duties and responsibilities under the provisions of the bill." The authority was apparently incorporated in the Act with the intention that it should be utilized only as a last resort.

The "guaranteed price" provision quoted above was intended not only to encourage mining but also to promote prospecting by assuring a profitable market for all materials discovered. Though prospecting may be desired, it is entirely possible that mining may not. If our supplies are relatively limited and we can acquire sufficient materials abroad for current operations and for a reasonable stockpile, it would appear to be better policy to leave our reserves unmined, available for a future emergency. In the altogether possible event the Commission should adopt this policy, it will be unable to utilize the price-fixing provision to encourage independent prospecting. Instead, it may decide to make a standing offer to buy land in which deposits of specified types are found. While not expressly mentioned in the Act, such a "guaranteed market" for land rather than extracted source material is probably within the Commission's powers. Other devices, such as finders' fees, may also be appropriate since the Commission's acquisition powers are broad and the legislative intent to favor independent prospecting clear. The report of the Senate Special Committee emphasizes "the necessity of encouraging the activities of independent prospectors," and states that in the Act "the traditional rights of and incentives to prospectors are substantially preserved."

In addition to its responsibility for promoting independent pros-

pecting, the Commission "is authorized to conduct and enter into contracts for the conduct of exploratory operations, investigations, and inspections to determine the location, extent, mode of occurrence, use, or conditions of deposits or supplies of source materials, making just compensation for any damage or injury occasioned thereby" [Section 5(b)(6)].

Note that the Act differentiates between "exploratory operations" and "investigations and inspections." It provides that the former may be conducted "*only with the consent of the owner,*" but investigations and inspections may be conducted "*with or without such consent.*" In making this distinction Congress was unquestionably attempting to reconcile the paramount public interest in the sources of atomic energy with a solicitous regard for the rights of private property. It is doubtful whether this desideratum could have been achieved by any device; certainly it was not by the expedient adopted. For exercise of the Commission's authority to requisition and condemn lands bearing source material may, in some instances, depend wholly on information that only exploratory operations can furnish. Should the owner of lands believed, on the basis of geological characteristics, to contain source material refuse either to conduct prospecting operations or to permit others to do so, it seems altogether clear that the Commission should have the right to take whatever steps it deems necessary to ascertain and develop the resources of the land. Presumably, Congress intended the Commission to meet this sort of contingency by exercising its right of investigation and inspection, a power that is not contingent on the owner's consent. But the distinction between "exploration" and "investigation and inspection" can scarcely be said to afford the Commission an unmistakable guide to action. The Senate Special Committee's report suggests that "exploratory operations" imply physical alterations of the property—in effect, small-scale mining operations—whereas "investigation and inspection" connote less drastic steps. If such indeed were the interpretation intended by Congress, the logic that dictated the provision seems faulty. The Commission, possessed of an unqualified power to condemn and

requisition source material, must have as an inescapable corollary of this power the means to acquire knowledge of existing supplies of such material. Normally, it should not be necessary for the Commission to resort to mining operations on private lands over an owner's objections in order to acquire such knowledge. However, since there are conceivable situations in which such operations may be required, the Commission must have the authority to perform them. It seems clear that the general purposes of the Act can best be served by a broad interpretation of the Commission's powers of "investigation and inspection" and as narrow a construction of the prohibition against "exploratory operations" as judicial ingenuity can contrive. The owner of the affected land would be fully compensated for any damage done or property taken.

This shortcoming in the Commission's prospecting authority is paralleled in limitations on its power to obtain reports of source material. As indicated earlier, reports of "any source material prior to removal from its place of deposit in nature" may not be required. All the objections to the limitations on the Commission's exploratory powers are equally if not more strongly applicable here. The Commission is given wide discretion in issuing licenses and in designing the entire pattern of control over source material. It was the evident intent of Congress that this discretion be so exercised as to cause minimum interference with private property rights and with independent prospecting and mining operations. Nonetheless, in view of the tremendous importance of source material, the Commission is given power to seize, by requisition or condemnation, any source material in the United States or any lands bearing deposits of source material. It is manifestly improper for the Commission to exercise these unusual powers except on the basis of complete information as to the location and nature of deposits throughout the United States. Certainly, under circumstances where requisition or condemnation is properly in contemplation, the Commission must have the right to obtain from the owner of the lands in question all necessary information and, if this is not forthcoming, to acquire the information by whatever means are necessary, including forcible investigations or explorations. Failing this interpretation, it is diffi-

cult to see how the Commission can ever perform its condemnation functions without risking the charge of arbitrary and unwarranted encroachment on private rights.

Source Material on Public Lands

Large areas of the mining lands in several western states, including Colorado, Wyoming, and Utah, are owned by the Federal government. From the geological characteristics of these areas there is every reason to believe that they contain deposits of source material. The Federal government has from time to time opened public lands to prospectors and leased or otherwise transferred title to portions of such lands for private exploitation. In drafting the Atomic Energy Act, the question arose as to whether this practice should be followed with respect to deposits of source material in public lands. It is clear that these deposits must be used primarily in the public interest and must always be available to the Commission for its production and research programs. This objective suggests ancillary policies. First, since public lands are frequently leased for private exploitation in other fields, provision should be made for the retention of federal ownership of deposits of source material, if and when found. Second, vigorous prospecting for new deposits of source material should be assured.

The first policy is effected by Section 5(b) (7) of the Act, which provides that all source materials "contained, in whatever concentration, in deposits in the public land are hereby reserved for the use of the United States subject to valid claims, rights, or privileges existing on the date of the enactment of this Act. . . ." * Similar reservations with respect to specified substances in some cases and all minerals in others are contained in various laws providing for the disposal of public lands.

Two points should be noted. First, ores containing source material "*in whatever concentration*" are reserved, privately owned ores

* This reservation is probably limited to "public lands" as distinguished from "acquired lands," lands obtained by the United States for a particular purpose. If this conclusion is judicially confirmed, the Act may require amendment.

being controlled only when they contain source material in certain minimum concentration. Second, the provision is not retroactive, in the sense that persons who acquired claims or other rights to public lands before the Atomic Energy Act went into effect are not affected by reservations of source material except as provided in previous mineral laws.

The policy is reinforced by certain obligations laid upon the Secretary of the Interior, whose department is steward of the public lands: "The Secretary of the Interior shall cause to be inserted in every patent, conveyance, lease, permit, or other authorization hereafter granted to use the public lands or their mineral resources, under any of which there might result the extraction of any materials so reserved, a reservation to the United States of all such materials, whether or not of commercial value, together with the right of the United States through its authorized agents or representatives at any time to enter upon the land and prospect for, mine, and remove the same, making just compensation for any damage or injury occasioned thereby" [Section 5(b)(7)].

Another provision of the same section is intended to offset any advantage in claiming public lands that may have accrued, by reason of unique and prior access to special information, to individuals or corporations participating in the Manhattan District Project. Thus, "no individual, corporation, partnership, or association, which had any part, directly or indirectly, in the development of the atomic bomb project, may benefit by any location, entry or settlement upon the public domain made after such individual, corporation, partnership or association took part in such project, if such individual, corporation, partnership, or association, by reason of having had such part in the development of the atomic bomb project, acquired confidential official information as to the existence of deposits of such uranium, thorium, or other materials in the specific lands upon which such location, entry, or settlement is made, and subsequent to the date of the enactment of this Act made such location, entry, or settlement or caused the same to be made for his, its, or their benefit." While this provision is limited to locations made after the Atomic Energy Act was passed, the President by

Executive Orders 9613 and 9701 had precluded any such claims between September, 1945, and the effective date of the Act. Despite the desirable objective of these measures, neither seems successfully to have vitiated any claims that may have been established on the basis of confidential knowledge prior to September, 1945.

To establish the principle of paramount public interest in and permanent public title to the source material located on public lands proved a relatively simple task. But while the reservations and limitations just described serve to keep under public dominion title to deposits of source material in federally owned lands, they do not promote prospecting activities that are equally vital to the development of atomic energy. Indeed, a simple reservation, without compensating factors, would remove all private incentive to engage in prospecting for source material on public lands.

To establish compensating factors that would mitigate this effect on private prospecting and the development of undiscovered resources proved much more difficult. The effort to accomplish this latter goal produced a series of complex and intricate provisions that may be summarized as follows:

1. Persons acquiring public lands by lease, transfer of title, etc., are authorized to engage in prospecting or in mining or to make any use of the land whatsoever, *just as if there were no reservation* of title to source material.

2. *But* when this use results in the extraction of source material in quantities that, had the extraction been made from private lands, would have required a license authorizing transfer or delivery, *such material shall be the property of the Commission.*

3. The Commission may then *either*

(a) require delivery of the source material after it has been separated from the ores in which it is contained, or

(b) waive its rights under (a), thereby automatically removing the effects of the original reservation.* The result, in other words, is as if either there had been no reservation of title originally or the

* In some cases mineral rights may have been reserved by other statutes as well. Such reservations are probably not affected by waiver under the Atomic Energy Act.

Commission had had an option on source material that it decided not to exercise. In any case, thereafter the owner of the source material must operate under the licensing system just as if the material had been extracted from private lands.

4. If the Commission requires delivery, it shall pay for the material such sums, including profits, as it "deems fair and reasonable for the discovery, mining, development, production, extraction, and other services . . . but such payment *shall not include* any amount on account of the value of such material before removal from its place of deposit in nature" [Section 5(b)(7)] (italics by authors). The method of computing payments is in accord with the reservation of title to the United States.

It may be doubted that this cumbrous mechanism will produce the results intended—particularly if the Commission decides that mining of domestic source materials should not be encouraged. This eventuality is altogether likely, as has been seen. The alternative in this event will be for the Commission to cooperate vigorously with the Secretary of the Interior in carrying out his responsibility under the Stockpiling Act to press prospecting for strategic minerals, on public as well as privately owned lands, and to devise special inducements to encourage prospecting on public lands of the types discussed above.

6. Radioactive By-products

> O, what a world of profit and delight,
> Of power, of honour, of omnipotence,
> Is promis'd to the studious artizan.
>
> Christopher Marlowe, *The Tragical History of Dr. Faustus,* Scene 1.

In 1896, the French physicist Henri Becquerel observed that a photographic plate that he had left in his desk drawer together with a quantity of uranium mineral had become unaccountably darkened. Deliberately reconstructing the accidental circumstances, he was led to the discovery of natural radioactivity. It was a finding of incalculable importance for the future of science and man. Concepts of matter and energy were to undergo radical revision. Practical uses encompassed by the discovery and by others to which it led are limitless. The atomic bomb is the most obvious example; fortunately, there are others of a more constructive nature.

Natural radioactivity is a property of certain elements—radium the best known—whereby they disintegrate, usually slowly, giving off particles and radiant energy drawn from their own substance. It is a process of degeneration and self-destruction whereby heavy elements are transformed into lighter, less complex ones. The emanating particles may be electrons, helium nuclei, positrons; the energy, gamma rays, short-wave X rays. In addition to uranium, at least forty radioactive elements occurring in nature have been identified by investigators following the path indicated by Becquerel. But this was only the first phase.

Having uncovered the existence of radioactive elements, evidently produced by natural forces, scientists were anxious to imitate and extend the process in the laboratory. Their problem was to find ammunition with which to thrust to the citadel of the atom—its

nucleus. If this succeeded, the effect would be to create disorder in the structure of the atom and instability in its mechanics with resultant radioactivity. As the matter is phrased in a well-known text on nuclear physics: "This process, the passage from one nearly stable state to one which is stable, is the underlying process of radioactivity. Every radioactive element is one which is off the beaten track; it is a freak, but a freak with the power to correct itself by changing its nature so that it returns to type." *

Curie and Joliot were among the first to force a breach in the nucleus of the atom. Bombarding certain elements with alpha particles emitted by the radioactive element polonium, they observed that some of the target substances not only emitted particles of their own during the process but also *continued to do so after the bombardment had ceased.* Here was radioactivity artificially induced, stable atoms converted into unstable atoms and seeking, by emanations, to attain an orderly, balanced, stable state, albeit undergoing transformation in the process. By 1940, physicists had made notable progress in the production of radioactive elements, in research on the underlying theory of radioactivity, and in practical applications of radioactive elements. A variety of devices were utilized in breaching the atomic nucleus, of which the cyclotron was the most effective. The efficiency of all these devices, however, was limited and their expense very great, so that research and therapeutic uses were necessarily restricted.

Production of Radioactive Material in Reactors

The situation was altered entirely with the discovery of how to sustain a nuclear chain reaction. For the reactor, or pile, in which uranium is transmuted into plutonium, is a rich source of elementary particles and radiant energy. Or, developing our earlier figure, the pile is at once an ordnance factory producing enormous quantities of subatomic ammunition and an artillery piece that fires ammunition at a prodigious rate. The neutrons produced in the chain reacting system are the bombarding particles causing either fission or

* Pollard and Davis, *Applied Nuclear Physics* (Wiley, New York, 1945), p. 102.

transmutation depending on their velocity. A great many of the neutrons do their work within the confines of the pile—its efficiency is determined by this proportion—but many escape to the surrounding region. They are accompanied by electrons, gamma rays, and other forms of radiant energy.

These escaping particles and radiations, which unless absorbed constitute a serious health hazard, serve as an incomparable agent for producing radioactive material. For by their impact on the nuclei of elements placed in their path, they create the new types of elements having the instability that is the prerequisite to radioactivity. If other elements or compounds are exposed to these particles and rays, they become radioactive to a degree depending, in general, on the duration of the exposure. Theory and practice are both relatively simple; the cost compared to the expense of earlier methods is insignificant; and the quantities of radioactive elements that can thus be produced are literally of a different order of magnitude from the quantities that could be produced by the most efficient earlier methods. Materials thus produced may be termed "incidental" by-products.

There is another less important means of making radioactive material in a pile. In the process of transmuting uranium to plutonium innumerable incidental fissions occur. The U-235 atoms, contained in the metallic uranium slugs in the pile, by capturing neutrons are blasted into fragments including more neutrons that continue a steady internecine bombardment. The casualties of this war, the fission fragments, are a variety of elements, their atomic numbers lying in a middle range in the atomic scale. Each fragment is an unstable isotope, highly radioactive.* These we denote "proper" by-products.

As defined in Section 5(c)(1) of the Act, "the term 'by-product material' means any radioactive substance (except fissionable material) yielded in or made radioactive by exposure to the radiation

* Only part of the neutrons generated by the U-235 produce fission. Others are captured, when their velocity is suitable, by U-238 atoms, constituting 99 per cent of the uranium in the pile. The product of neutron plus U-238 gives U-239, which by spontaneous radioactive "decay" converts first to neptunium, then to plutonium.

incident to the processes of producing or utilizing fissionable material." The definition is clearly so comprehensive as to cover all by-product materials produced by or in a pile, whether "incidental" or "proper." But it goes further, since it extends to radioactive material produced incident to the *utilization* of fissionable material. This must be understood to embrace not only utilization in large-scale government-owned production facilities, which, as we have seen, utilize as well as produce fissionable material, but every type of atomic energy device or research apparatus utilizing (or producing) fissionable material and producing radioactive substances in the process. Controls over by-product materials are limited, however, and in spite of their scope should add burdens neither to the Commission nor to the scientific or commercial user. (A possible exception to this generalization is noted below.)

Although fissionable material is radioactive, it is excluded from the category of "by-product materials" by the terms of the definition. For purposes of the Act, then, by-product materials are not fissionable. They do not affect the national security.* Consequently, they do not require the detailed system of controls designed for fissionable material. It was considered unnecessary to impose any restriction on the manufacture, transfer, acquisition, or ownership of by-product materials.

However, the Commission has the responsibility of determining in the first instance what quantities of by-product materials will be produced in government facilities by deliberate exposure of substances to the escaping neutrons of the pile and for establishing a distribution policy to fix priorities among various claimants, to

* Except, of course, that new weapons, perhaps even more effective than atomic bombs, utilizing radioactive by-products in the form of a lethal dust or gas to be spread over wide areas of enemy territory, are in the course of development. (The War Department has authorized a number of releases covering the subject.) While the possibility was not in contemplation at the time the Act was drafted, it is doubtful that the quantities of radioactive by-products that the Commission will distribute will raise security problems. If circumstances should change, the Commission has ample authority to keep the traffic in by-products under tight supervision. (See also Second Semiannual Report of the United States Atomic Energy Commission, Eightieth Congress, First Session, Document No. 96 (United States Government Printing Office, Washington, 1947), in which the Commission reports it "is establishing proving grounds in the Pacific for routine experiments and tests of atomic weapons.")

set prices and perhaps price differentials for certain types of uses, and to enforce safety standards. As a result of a flaw in the drafting of the Act, the Commission may also have to perform the unintended function of licensing certain industrial uses.

The Uses of By-product Materials

The possible constructive applications of these by-product materials and their potential contribution to human welfare have been largely concealed from public attention by the blinding flash of the bomb. Because the nature of these uses must in large measure determine the Commission's policies in producing and distributing by-product materials, it seems appropriate at this point to include a brief summary of developments that have already taken place in this field and an indication of the directions in which scientists think future progress is most likely.

Radiations from radioactive elements may be used in at least two ways: (1) as sources of information regarding structure and function and (2) as agents for altering structure and function. Elements that are radioactive give forth, like tiny radio transmitters, electromagnetic waves that can be located and measured. They also emit subatomic particles that can be registered through such sensitive devices as a Geiger counter. If these particles are permitted to fall on a specially prepared photographic plate, they form an image, a "radioautograph," the contours of which correspond roughly to the actual distribution pattern of their parent source. When placed anywhere in an organic or inorganic system, a quantity of radioactive material will disclose its location and thus reveal something of the surrounding structure. If it is moving through the human body, its path and the time consumed in passing through and in absorption by an organ can be observed and invaluable data as to function acquired. This is the basic principle of the tracer technique.

As we have stated, bombarding particles and radiant energy are capable of making other atoms unstable. The ensuing changes affect molecular structure and can gradually bring about transformations

of masses such as crystals or organic cells that are huge in comparison to the activating particles. This is the chain of action characterizing the second use of radioactive elements. For convenience, we may refer to it as the bombardment technique.

What we have described is, of course, oversimplified, but it may serve our purpose in what follows.

Research Uses

Fundamental research in nuclear physics and the physics of solids is and will be increasingly furthered by the use of radioactive elements. Both the tracer and the bombardment techniques will serve in studying crystal arrangements and magnetic properties. Impurities in solids may be detected to a degree of precision hitherto undreamed of.

The use of tracers or tagged atoms for the study of biological processes and of chemical and metallurgical structures and changes is rich in possibilities. The moving tagged atoms will transmit their messages as they go along, describing regions and reactions hitherto unknown and wholly inaccessible to the most powerful optical and X-ray instruments. With radioactive substances cheap and plentiful, they can be used to study and improve many industrial processes. Pioneering work has already been done with radioactive phosphorus, sodium, and antimony in biology and chemistry. Pathbreaking as these researches have been, they are only the barest beginning.

A line of unusually fruitful exploration stretches from the fundamental organic element carbon. A particular kind of radio-carbon, called Carbon-14, "is an invaluable research tool in unraveling vital processes in both animals and plants. It has already been used in preliminary attempts to understand the nature of photosynthesis —the process by which plant leaves use sunlight to convert water and carbon dioxide into starches and sugars. Complete understanding of this process might . . . enable us to use sunlight or artificial power to make starches directly without the help of growing plants." *

* Los Alamos Scientists, *Our Atomic World* (University of New Mexico Press, Albuquerque, N. M., 1946), p. 54.

Medical Uses

In medical diagnosis and therapy the possibilities of radioactive elements are almost unbounded. The use of radium in the treatment of cancer has been limited not only because it is costly and scarce but also because its radiations are not selective; they blindly destroy healthy and cancerous tissue alike. The obstacles of scarcity and scandalous cost should vanish with the new processes, which can readily and inexpensively produce what promise to be effective substitutes for radium.

But much more important, these new processes promise to make possible the production of radiumlike substances that will be selective in their action. Certain elements have an affinity for certain tissues and organs of the body. Phosphorus, for example, when absorbed goes into the bony structure within five days. Iodine moves to the thyroid gland; iron to the red corpuscles of the blood. Certain elements select particular tissue and their radiations may be controlled as to range and velocity and confined as to area of effectiveness by the use of other elements injected into the tissue. Thus, it has been suggested that if boron is injected into cancerous tissue and is then bombarded by neutrons, its intense rays will travel only a very short distance, thereby affecting only the immediate neighborhood and not moving on to destroy healthy tissue.

The attributes of the affinity between various elements and organic tissue, the speed and degree of absorption of elements by the body, the functioning of organs, diseased or healthy, the processes of digestion and metabolism, the chemical effects of various elements on various tissues, and the physiological effects of neutrons and gamma radiation are among the many relations and processes that can be studied and perhaps controlled through radioactive elements. Finally, the nature of life itself, the key factors of genetics, growth, and death may be brought into the reach of understanding.

Power

While it is clear that the atomic nucleus can furnish controlled power for peacetime uses as readily as power for the bomb, it is

equally clear that atomic power plants, for the present at least, will be large, costly, heavily shielded installations. The dream of atomic automobiles, aircraft, or heating units for individual homes remains a dream. The entire subject is too new to see in perspective, either in its technical or its economic aspects. But on the basis of present knowledge ingenious proposals have been put forward for overcoming the difficulties indicated. One, in particular, contemplates the use of radioactive elements as the basis of "atomic storage batteries" that could furnish power when, where, and how needed. A special technique has been suggested by a well-known physicist to utilize the heat-producing properties of radioactive by-products for power:

> . . . we can accumulate the uranium energy produced in large central plants *in some kind of special "atomic storage batteries."* . . . The radioactive elements . . . will provide a constant source of heat to be used in the power-generators, and will be completely free from the possibility of atomic explosion. If we select, from the large variety of such elements, those which have a suitable decay period and also do not possess specifically strong gamma radiation, we can produce heating units adaptable for every purpose . . . for big transatlantic air liners, or . . . for model airplanes of our air-minded young generation.*

While not all scientists would share Gamow's optimism, the use of radioactive by-products as a practical source of energy is sufficiently possible to deserve serious study.

Professor Gamow also suggests the possible utilization of these materials in the propulsion machinery for rockets or other interplanetary craft. It will perhaps afford some comfort to those who like to look on the bright side to reflect that this power with which man threatens to destroy the earth may afford him means of escape from its shambles to some new world where perhaps there is no U-235.

* G. Gamow, *Atomic Energy in Cosmic and Human Life* (Macmillan, New York, 1946), p. 153 *et seq.*

Distribution of By-product Materials

Such, then, are the properties and potentialities of by-product materials. In view of the enormous promise they hold out to fundamental science, medicine, and industry, it is to be expected that the demand for them will be almost illimitable. Initially, their most extensive use will be in research, and demand will be limited by suitable research facilities. Once devices begin to be perfected that make practical use of the materials, demand is likely to grow to dimensions that the Commission will find it difficult to satisfy.

The Act gives some guidance as to distribution policy: "The Commission is authorized to distribute, with or without charge, by-product materials to applicants seeking such materials for research or development activity, medical therapy, industrial uses, or such other useful applications as may be developed." Preference shall be given "to applicants proposing to use such materials in the conduct of research and development activity or medical therapy." During the early period when most applicants seek materials for research and development purposes, this provision cannot relieve the Commission from the necessity of making its own value judgments. After industrial applications have begun to be developed in significant numbers, it does assure a priority for medical and research and development purposes. However, if materials are not available in sufficient quantities to make their utilization in industrial devices possible on a commercial scale, the inevitable effect will be to dampen the zeal for research. The inference seems to be clear. The Commission must as soon as possible survey its facilities, determine the maximum production of by-product materials, and seek to keep production at a level that will offer the maximum inducement to private laboratories and industrial concerns to pursue activities in the field of research and development of practical applications.*

* The Commission's Second Semiannual Report to Congress states (p. 25) that "more than ninety different kinds of isotopes, representing more than sixty elements, are now being produced for distribution to our country's scientists." The place of production is the Clinton Laboratory at Oak Ridge, Tennessee. Costs of production are far below prewar costs when the cyclotron was used to make isotopes. "A striking example of this reduction in cost is shown by that extremely useful radioisotope—carbon 14. It has been estimated that one milli-

The authority conferred upon the Commission to distribute materials "with or without charge" should be useful in enabling it to encourage specific uses. Presumably, if desired, the provision can be construed to authorize differential pricing as well, so that the Commission, in effect, can subsidize certain types of uses during their earlier stages when commercial prospects are dubious and increase the price as the ventures become more firmly established. The application of a policy of this sort, however attractive in principle, is a thorny problem in a democratic system of free enterprise, where vested interests are hypersensitive to the effects of state aid to possible competitors. In this field the Commission will no doubt go slowly and seek the counsel and support of the joint Congressional Committee.

Under the terms of the Act, applicants must disclose the purpose for which by-products will be used and, if the materials are used "in a manner other than as disclosed in the application therefor," the Commission is authorized to recall them.

There is no prohibition on the export of by-product materials, so the Commission is left free to apply a selective system of such exports calculated to further world-wide progress in scientific research.*

curie of carbon 14, now being sold for $50, would cost about $1,000,000 to produce using a cyclotron." The Commission reports (p. 26) that its prices for isotopes "cover incremental costs of preparation and shipping, but no attempt is made to cover any part of the cost of reactor design or construction. Low prices should encourage the most rapid development of the many potential uses of these materials."

* The report of the Commission's Medical Board of Review (June 20, 1947, p. 5) states, "The time is approaching when the supply of isotopes for the study of fundamental biological and medical problems will more than meet the needs of American investigators. It would be in the interest of progress in medicine and biology that qualified investigators in other countries have such isotopes for their studies. We suggest that steps be taken to make isotopes available to foreign investigators." On September 3, 1947, President Truman announced that production of radioisotopes were now available for "limited distribution" to qualified research workers in other countries for biological and medical research. Among the conditions governing distributions are the following: "Foreign governments must agree to make progress reports to the Commission every six months and to permit publication of the reports; they must insure that the radioisotopes are used for the activities approved; and they must permit scientists of every nationality to observe experiments and obtain information freely." See United States Atomic Energy Commission Release No. 52, September 4, 1947.

Possible Applicability of Licensing Provisions to By-product Materials

Despite the apparent straightforwardness of the section under discussion, analysis reveals a curious and troublesome ambiguity with respect to radioactive substances. This ambiguity is created by the definition of atomic energy, a definition that must certainly have been formulated with care. According to Section 18(a), "'atomic energy' shall be construed to mean all forms of energy released in the course of or as a result of nuclear fission or nuclear transformation." Now the term "nuclear fission," it is agreed among scientists, means a real fracture or splitting of the atomic nucleus into two fragments roughly of even mass, as against a mere 'chipping.' What takes place when the U-235 or plutonium in an atomic bomb releases its energy in a tremendous chain reaction is an obvious illustration of nuclear fission. But the term "nuclear transformation," while it might be considered a less graphic synonym for "nuclear fission," evidently also describes the phenomenon of radioactivity. For note that the basis of radioactivity, the transition from an unstable to a stable isotope, from a complex element to a simple one, involves a definite change or transformation not merely in the outer shell of electrons but also in the nucleus of the atom itself.

To what are we led by these considerations? Simply this, that *radioactivity gives rise to forms of atomic energy* (as the term is defined in the Act), even though these may be quantitatively negligible by comparison with the amounts released in a chain reaction. This conclusion is of serious consequence to controls in the present section as well as to those of other sections of the Act, the licensing provisions in particular. Section 7 (controlling the utilization of atomic energy) makes it unlawful for any person ". . . to utilize . . . atomic energy with or without . . . (any) equipment or device, except under and in accordance with a license issued by the Commission authorizing such . . . utilization." Although the obvious intent of this provision was to regulate devices utilizing fission-

able material, that is not all the language imports. For it reads "atomic energy" and thereby includes the entire class of phenomena, involving radioactivity and all uses of radioactive substances. By the same token patents on devices utilizing by-product materials would be subject to Section 11, discussed in Chapter 8.

There is good reason to conclude that Congress did not intend the licensing or patents sections to apply to by-product devices. Nowhere in the legislative history is radioactivity referred to as a "nuclear transformation"; nowhere are by-product devices described as subject to licensing or patent controls. While the ownership, possession, and transfer of fissionable material are closely regulated, radioactive by-products may be freely moved and transferred subject only to the observance of health and safety standards. Whereas fissionable material may be distributed for an industrial use only if the use is properly licensed, no such limitation is imposed upon the distribution of by-product materials. In short, if Congress did in fact intend that the licensing and patent sections should apply to by-products, it chose a singularly indirect and tortuous means to effect its purpose and one far less carefully supported than any other control in the Act.

If, in spite of these considerations, it should be decided that these sections do apply to by-product materials, the Commission would be well advised to adopt the policy of granting automatic licenses to most categories of industrial uses. But where the use of radioactive material might give rise to economic and social problems similar to those anticipated in the case of atomic energy devices utilizing fissionable material, there may be good reason for resorting to licensing controls and transferring to Congress responsibility for the ultimate decision. An apposite example would be Professor Gamow's atomic storage battery, furnishing power from radioactive sources.

In any case, the ambivalence of the language in the Act, the apparent inconsistency between the by-products section and the licensing section arising from the definition of atomic energy, will force the Commission to a stand that may have to undergo the

scrutiny of the courts. If no satisfactory way out of the difficulties caused by the ambiguity can be found within the framework of the Act, a perfecting amendment by Congress may ultimately be required.

Protection of Health and Safety

Although, as we have seen, by-product materials raise no security problem, their improper use may nevertheless create serious hazards to public health and safety. To prevent such dangers, the Commission has been granted ample regulatory powers. The production of radioactive material as an incident to the operation of a pile making plutonium presents no problems; since such production is a government monopoly, safety standards governing the operation of the pile must be set by the Commission. Under Section 12(a)(2) the Commission has the general authority to "establish by regulation or order such standards and instructions to govern the possession and use of fissionable and by-product materials as [it] . . . may deem necessary or desirable to protect health . . . ," etc. And, under Section 10(c), these controls are implemented by authority to inspect and require reports. As to piles or other facilities and apparatus privately operated in the course of federally supported research and development activities, Section 3(a) specifically provides that all such arrangements shall contain provisions "to protect health, to minimize danger from explosion and other hazards to life or property, and to require the reporting and permit the inspection of work performed thereunder. . . ." Furthermore, in licensing the use of atomic energy devices, which, as pointed out above, may in some cases include devices utilizing by-product materials, Section 7(c) provides that licensees must at all times be equipped to observe safety standards; the Commission may refuse to issue licenses for failure to meet the requirements or may revoke a license for the same reason.

The Control of Information

Security factors not being involved, the control of information relating to by-product materials should be administered with a light hand. Control of information, in general, is limited to "restricted data." These are defined [Section 10(b)(1)] as "all data concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power. . . ." True, the Commission, if it chose, might interpret "data concerning . . . the production of fissionable material" to mean information on radioactive by-products. It is not likely to do so except where the information has a direct bearing on or would serve to reveal some restricted phase of the production of fissionable material.

A difficulty arises, however, that the Commission must resolve in practice. The categories of information loosely gathered within the far-flung net of "restricted data," as the Manhattan District employed the classification, remain restricted until "unrestricted" by act of the Commission. In the absence of a specific action on the precise point at issue, any individual who makes his own interpretation of what the net does not include will do so at his peril. The theory and use of radioactive materials are of the highest value; but their full benefit can be derived only if the relevant scientific data are published and made freely available to scientists everywhere. Thus, the Commission must remove every ambiguity and uncertainty that might retard the publication of data on radioactive materials by making it clear at the earliest opportunity that all but certain specific data bearing on security factors are free from information controls.

7. Industrial and Commercial Uses

The complete circle of scientific activity is not closed with the making of a discovery; it is only closed when that discovery is fully incorporated, both as an idea and as a practical application, in contemporary society.

Bernal, *The Social Function of Science* (Macmillan, New York, 1939), p. 321.

We are in great haste to construct a magnetic telegraph from Maine to Texas; but Maine and Texas, it may be, have nothing important to communicate.

H. D. Thoreau, *Walden*.

As we have seen, in framing the control system, the draftsmen of the Act had security as their touchstone, and this fact accounts in large measure for the character of the provisions they drew. Operations concerned with the production and distribution of fissionable material were considered to be of too great an import to the national security to be left in private hands. State monopoly of production and ownership of these materials was therefore established, their private possession and use placed under close supervision, and all private transactions involving them prohibited.

Certain other operations were not thought to constitute a significant threat to the national security. Therefore, private persons were permitted to undertake these operations without specific authorization, subject only to the general inspection powers of the Commission, its safety regulations, and the indirect controls it might exercise through its power to grant or withhold from applicants the products of its fissionable material plants. Operations in this category include the following: (1) research in nuclear processes, the

theory and production of atomic energy, and the utilization of fissionable and radioactive material; (2) the utilization of fissionable and radioactive by-product materials for medical therapy and the manufacture of equipment and devices utilizing such materials for this purpose; (3) the utilization of by-product materials and the manufacture of devices utilizing such materials for industrial purposes.

These matters have been discussed in the preceding chapters and require no further comment here. There is yet another type of operation, however, that does not fall wholly in either of the two categories listed above. Between these two relatively clearly defined areas there lies a third, vast and unbounded, to which no a priori principle could be applied. In this area fall those operations that indirectly involve the national security and those that it seems might generate portentous economic and social consequences. Since there was no way to reduce to a common standard a range of dangers to the national security extending from negligible to acute or to measure the consequences of industrial applications of atomic energy that remain to be invented, Congress decided that in this field the only practical expedient was to endow the Commission with a power flexible enough to deal with any contingency. The licensing authority was adopted to fulfill this purpose.

We have already considered the application of the licensing authority to transactions involving source material and to the manufacture and transfer of equipment to be used in the production of fissionable material, both cases in which the power was intended to serve security purposes. The application of the licensing authority in the field of industrial and commercial uses of atomic energy is considered in the present chapter. It is in this field that a new technological era will be shaped if men somehow succeed in winning through to an international regime of law and, freed of the dread of the bomb's apocalyptic detonation, devote themselves to the development of atomic energy for constructive purposes. What changes impend we can only dimly guess, but we can be sure that they will be many and of the most profound significance to our economy, the structure of our society, and our whole way of life.

It appears certain that within our generation, further discoveries in the science of nuclear physics and a steadily growing number of inventions applying atomic energy to industrial and commercial ends will confront the Commission with decisions calling for the highest order of political judgment. The licensing of a particular industrial application of atomic energy may affect the fortunes of millions of people—some favorably, some unfavorably—powerful economic interests may be lined up on either side, creating the calliope din with which they invariably greet such occasions. This much it was possible to foresee; however, the range of the decisions that might be required was too great, their nature too dimly perceived to enable Congress to set forth any specific and practically useful guides to policy that the Commission might follow in passing on applications. In view of these factors Congress decided to make itself a party to all such decisions, reserving the right to review and to veto contemplated actions of the Commission in this field.

Before analyzing this provision of the Act in detail, it is perhaps desirable to summarize the existing knowledge about possible applications of atomic energy and the forecasts that the best-informed nuclear scientists have been willing to make concerning the foreseeable course of future developments. These were the data and the assumptions available to Congress when the licensing section of the Act was drafted.

Possible Industrial and Commercial Uses of Atomic Energy

Since the dropping of the bomb most of us have dimly felt that the human race would before too long either destroy itself or embark upon a new technical era of fabulous contours. This intuition, vague as it is, is probably unique in the history of the world. Certainly it did not accompany the invention of the steam engine or of the basic principles of electricity. There were no contemporaries of Watt who recorded their conviction that the curious instrument he had contrived would produce momentous changes in human lives. There was none among the philosophers of the period who, pondering upon the implications of the contrivance, predicted the indus-

trial revolution, the multiplication of the population of the western world, or the rise of the proletariat. Nor does it appear that contemporaries of Faraday foresaw radio and radar or the manner in which these electrical devices would be made to serve the purposes of mass deception and mass slaughter.

However, there appears to be no particular reason for us to congratulate ourselves on the heightened sensitivity of our perceptions over those of our ancestors. Our vague intuition that atomic energy may destroy or reshape the world is no doubt more the product of the incomparably dramatic demonstration at Hiroshima than of the evolutionary progress of the human race. And when we examine the available literature on the probable consequences and implications of the uses of atomic energy we conclude that, though it may exhibit an increased command of lurid prose on the part of the journalistic profession, it does not testify to remarkable progress in our ability to predict the technological consequences of a new scientific principle or to chart the future course of its social impact.

The scientific popularizers, to be sure, profess to see the future written plainly, as if in neon lights, and they describe for us a wondrous universe in which planes carrying several thousand passengers will make nonstop flights from New York to India; automobiles will be propelled for a year on a pellet of atomic energy the size of a vitamin pill; houses will be heated by capsules; rare elements will be made as common as clay; and sunshine will be on tap, like hot water.*

But in the sober realm of the scientists there is a cautious reserve. Atomic energy may eventually revolutionize the world, but the scientists are not certain just how this will happen. They are sure that atomic energy can be used as a source of power in large installations—though on the basis of present knowledge there is little prospect of its utilization for the propulsion of vehicles smaller than ships—and they estimate that the utilization of atomic energy for power generation may prove to be an economical operation in certain regions within the very near future. They are sure that signifi-

* David Dietz, *Atomic Energy in the Coming Era* (Dodd, Mead & Company, Inc., New York, 1945).

cant discoveries in fundamental science and medical therapy will be made possible by the use of radioactive material. And beyond these tentative suggestions, they do not choose to venture.

There has always, of course, been a time lag, sometimes of very extended duration, between the discovery of an important new scientific principle and the working out of its full technological implications. That wonder of the nineteenth century, the steam engine, was based mainly on the theory of the behavior of elastic fluids, already fixed in the seventeenth century. The principle of electromagnetic induction was discovered in 1831, but the first commercial dynamo was not constructed until fifty years later. More than forty years elapsed between the formulation of Einstein's theorem, which is the foundation stone in the structure of nuclear physics, and the first large-scale release of atomic energy. Where a new scientific discovery makes possible the development of devices, techniques, and products of a nature quite inconceivable within the limits of previous knowledge, the time lag in developments may be greater and the task of predicting their course certainly becomes immeasurably more difficult. We have witnessed the remarkable and unpredictable developments in textiles and drugs that have grown out of the discovery of the technique for making aniline dyes. In the case of atomic energy, the task of prediction is certainly no less difficult. The most important primary consequence of recent discoveries in this field is the certainty that from them will be developed further profoundly significant advances in basic science. These further advances will multiply in innumerable unforeseeable directions, generating inventions and resulting in industrial applications in turn.

Since we cannot foresee what the new discoveries will be and therefore cannot possibly guess what industrial applications will flow from them, it is perhaps understandable that our social scientists have not as yet prepared blueprints of the new society that these industrial uses will produce. We can only be certain that, if the industrial uses of atomic energy prove to be as numerous and as important as we expect, their economic, social and political consequences will be momentous.

Research

What the scientists tell us about the further significant discoveries in fundamental science that may result from the use of radioactive material in research has already been sketched in the chapter on by-product materials. There is little that need be added here for fissionable material. This material may be used in certain researches where by-product material is ineffective, but the results will not differ in kind. They are, for example, expected to contribute enormously to the understanding of nuclear forces and the physics of solids. In the field of nuclear physics many experiments can be done with the aid of the intense radiations produced in piles that would be impossible with weaker atomic radiations.

Power *

Of all the various industrial applications of atomic energy that will in time be made, its utilization for power purposes seems closest to realization. Great amounts of heat are generated from the operation of piles for the making of plutonium, and though (so far as is officially known) such heat has been used for no purpose more practical than tempering the waters of the Columbia River in the neighborhood of Hanford, Washington, and certain technical problems remain to be solved, there is every reason to think that this by-product heat could be effectively utilized as a source of electrical power. New plants for plutonium production will no doubt be so designed as to permit the utilization of heat generated in the process.

Although knowledge of the problems involved is still fragmentary and development work remains to be done, scientists are convinced that it is now possible to construct a plant specifically for the purpose of power generation that would in some places, at any rate, be economically feasible.† The evidence as to the nature of these plants is incomplete and two principal questions remain to be answered. The first is whether a sufficient amount of nuclear fuel can

* For an interesting discussion of some of the problems involved in generating useful power from atomic energy, see Sir Wallace Akers' lecture before the Institute of Metals, May 21, 1947 (summarized in *Nature*, August 9, 1947, 160:182).

† Scientific information transmitted to the United Nations Atomic Energy Commission by the United States Representative, Vol. IV (1946).

be produced in a power reactor to replace the amount consumed in the generation of heat for power purposes. The answer to this question will fix the limits to the possible utilization of atomic energy for power purposes. The second is the problem of whether nuclear fuels can be effectively *denatured* and utilized in power reactors that do not lend themselves to the production of fissionable material. On the answer to this question depends whether or not private operation of atomic power reactors will be permitted under the Act.

With respect to the first question, as already indicated in Chapter 3, published reports * convey some hints that it may be possible to produce more nuclear fuel than the amount consumed in the process of heat generation. If this is the case, it means that the amount of fissionable material ultimately available is not limited to the amount of U-235 we can obtain multiplied a few times by the amount of U-238 that can be converted into plutonium and the amount of thorium that can be converted into U-233 under bombardment by U-235. The amount may be several hundred times larger, nearly equal to the total uranium and thorium deposits in the world. It is not necessary to emphasize the obvious point that whether fissionable material is limited to an amount only several times as great as the U-235 available or is in fact several hundred times greater again, it will still have enormous significance for the policies of the Commission and will determine whether the use of atomic energy for power purposes will be encouraged or discouraged. Power reactors of the type mentioned here will, of course, raise no licensing problems. Since they will use fissionable material as fuel and will generate additional quantities of fissionable material in the course of operations, they must under the terms of the Act fall within the government monopoly.

With respect to the second question no private operation of reactors generating power will be possible unless denaturing of fissionable material can be made effective. Denatured material would clearly come under the definition of fissionable material provided in the Act, since it would of necessity comprise plutonium, uranium

* *Ibid.*

enriched in the isotope 235, or other material deemed capable of releasing a chain reaction. Hence it would be subject to Section 5(a)(4), which provides that "such material shall be distributed in such quantities and on such terms that no applicant will be enabled to obtain an amount sufficient to construct a bomb or other military weapon." Since fairly considerable quantities of material will be necessary for power generation, unless the Commission is able to find that denatured material cannot be utilized to construct a bomb or other military weapon, all private operation of atomic power projects (at least as far as the reactor part of the process is concerned) will be enjoined.

The Acheson-Lilienthal report, containing the first information made public on this point, stated definitely that effective denaturing was altogether feasible, that large-scale projects for the generation of power from atomic sources might be safely entrusted to private individuals, provided that effective inspection was coupled with control of source material, and, further, that unless additional quantities of uranium or thorium were exposed to the denatured material during its consumption in nuclear fission, additional fissionable material could not result.

Since the publication of the Acheson-Lilienthal report, some doubt has been cast on the correctness of its thesis that it is possible so effectively to denature fissionable material that it could not be rendered fissionable again except by treatment in very large, specialized installations. At the present time the whole problem must be counted in doubt and judgment withheld until further data are developed. In any event, it is clear that operations of the sort envisaged cannot be commenced until extensive and costly development work has been completed and considerable stocks of denatured material accumulated. These facts point to the conclusion that private ownership of nuclear power reactors is still some distance in the future.

In the event that the technical problems now foreseen can be satisfactorily solved, it is estimated that, on the basis of the existing fundamental knowledge, it will be possible to design and build a plant that will produce power from atomic energy at a cost about

10 per cent to 20 per cent higher than that of generating electricity from coal in present thermal plants.* This finding has the ring of anticlimax to one whose vision of the atomic world has been conditioned by the popular science books of Jeans and Eddington, which as long ago as the 1920's pictured the marvels to come from the unlocking of nuclear energy. In these books we learned that there is enough energy in a thimbleful of water to propel giant liners back and forth across the ocean. But in the present state of nuclear science we are able to realize only a minute fraction of the total power potentially available in the uranium atom. According to Einstein's classical mass-energy principle, a pound of any substance is equivalent to the energy obtained in burning 1,500,000 tons of coal. In the fission of U-235 and plutonium we have so far been able to release from a pound of matter energy equal to 1,400 tons of coal. Thus practice realizes only $\frac{1}{1000}$ theoretical efficiency.

On the basis of present efficiency atomic power will be useful in certain parts of the world where coal and water power are not available. Significant progress in plant design and efficiency may result in the production of atomic power at costs substantially less than coal power. Until the costly development work on plant design has been completed and a demonstration of efficiency made, however, there will be small inclination on the part of private industry to enter this highly speculative field.

Even assuming that the problems of making an effective denatured material and an efficient plant are solved and private capital seeks to take over the field of atomic power production, the position of the government must continue to be dominant. The denatured material to be used in the power reactors must in the first instance be produced in government plants, and in the course of such production power is generated as a by-product. The Acheson-Lilienthal report estimates that, for every kilowatt generated in "safe" secondary reactors, about 1 kilowatt must be generated in "dangerous" ones that manufacture the material consumed in the secondary reactors.

* *Ibid.*

Should denatured material prove impractical for private use in producing atomic power, the only sources of such power within the bounds of legislation would be the by-product power generated in the Commission's production of fissionable material plus such power as the Commission might produce in operating experimental power reactors. The Commission is not empowered by the Act to build and operate its own plants for the commercial distribution of atomic power. While the Act fails to prohibit this activity in explicit terms, the conclusion is nevertheless evident from its failure to confer a power of such proportions upon the Commission as against its express treatment of by-product power.

Mobile Power Units

At the present time intense radioactivity accompanying the utilization of atomic energy for power purposes can only be contained by means of large concrete and lead walls of enormous weight. This factor appears to preclude effectively the utilization of atomic power in small motors such as those used to propel automobiles, trains, or airplanes, though perhaps not in large vessels.

The Licensing Authority

Scope

The licensing device has had a fairly extensive application in federal regulatory practice. It has been applied, among other things, to common carriers, radio and television transmission, and liquor dispensers. It has proved itself an effective instrument, and when, as in the case of a license issued under the Atomic Energy Act, it may be revoked at the discretion of the regulatory agency (subject to due process requirements), the control exercised under license may be very complete.

It has been discussed that source material and devices for the production of fissionable material are subject to the licensing power of the Commission. Our task now is to consider the applica-

n of this power to devices utilizing atomic energy. The terms of ction 7 are sweeping. Except for the purposes of research or edical therapy or for the production of military weapons by the med services upon specific authorization by the President, a license om the Commission is required for any person to "manufacture, oduce, or export any equipment or device utilizing fissionable aterial or atomic energy or to utilize fissionable material or atomic ıergy with or without such equipment or device . . ." [Section (a)]. Both the manufacture and use of the device are covered.

What is a device utilizing fissionable material or atomic energy? he definition furnished in Section 18(f) specifies "any equipment r device capable of making use of fissionable material" (a fairly pecialized category) or "peculiarly adapted for making use of tomic energy" (presumably, not including standard electrical gen- rating and transmission equipment or standard power-plant ap- aratus) and "any component part especially designed for such quipment or devices," all "as determined by the Commission." hus here, as in the case of production facilities, the Commission s entrusted with the authority to develop the definition, including n it such equipment as may be of significance and excluding by lefinition equipment for which licensing controls are deemed un- ıecessary. It was apparently the intent of Congress to include only hose devices having a unique utility in relation to fissionable ma- erial or atomic energy.

Policy

The Commission is given little specific guidance as to the manner in which this sweeping authority is to be exercised. The general policy declaration states the object of developing and utilizing atomic energy toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace. And in Section 7 these generalizations are made somewhat more specific in the mandate to the Commission to promote free competition by issuing as many licenses as possible, except where activities under license might serve to foster the growth of monopoly or the restraint of trade. These generaliza-

tions provide only the most sketchy policy guidance in a field vastly portentous for the future of the country. This deficiency in the Act may, however, be mended by Congress upon the submission to it by the Commission of specific licensing proposals, as will appear in the discussion below.

Nature of the License

The description of the nature of the license to be issued is specific enough. The license shall be nonexclusive, issued for a specified period, and revocable in accordance with such procedures as the Commission may establish. The power thus granted seems to be plenary, but it is qualified by the due process clause of the Constitution, the Administrative Procedure Act,* and the fact that policies and procedures governing the issuance and revocation of licenses of a particular class will doubtless be fully described in the report of the Commission to Congress recommending the issuance of the license and delineating standards by which the Commission will be subsequently bound. Once the granting of certain categories of licenses has been approved by Congress, the Commission must, in consonance with the Act, encourage the widest possible use, consistent with the maintenance of safety and security standards of the devices covered. Where supplies of fissionable material are limited, the Commission faces a task analogous to that of the Federal Communications Commission in attempting to discriminate among applicants in the allocation of the limited number of wave lengths available. As to revocation, the power would obviously not be exercised unless cause were given—*e.g.*, the failure of the licensee to observe safety standards or his inability to produce results of practical usefulness proportionate to the amount of fissionable material consumed.

The granting of the license is conditioned upon the agreement of the licensee to make available such technical information as the Commission determines necessary to encourage similar activities by as many licensees as possible. The regulatory position of the

* 5 U.S.C. § 1001 *et seq.*, especially Sec. 1009. See p. 279 for a discussion of the possible effect of this Act on the discretion of the Commission under the licensing authority.

Commission and its monopoly of fissionable material are thus to be used in order to force the widest possible dissemination of technical information and the greatest possible number of participants in the productive process. The powers available to the Commission to revoke the license or to shut off supplies of fissionable material should assure cooperation on the part of licensees. The theory underlying this provision, like that underlying the patent section of the Act, is at variance with the accepted dogma of our economic system that the progress of the industrial arts can be assured only by the profit motive, and that, unless the benefits of new discoveries are made to inure to the profit of the discoverer, they will not be made at all. The provision under discussion rests in part on the assumption that progress can be best made and society best served under a system that assures the pooling of knowledge and permits no one to achieve a privileged position by virtue of the exclusive right to use certain processes or techniques. The testing of this thesis in application will have more than academic interest.

Prohibitions on Licensing

The prohibitions on licensing contained in Section 7(c) are almost identical with those on the distribution of fissionable material set forth in Section 5(d)(1). The Commission is forbidden to give a license "to any person for activities that are not under or within the jurisdiction of the United States, to any foreign government or to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security." This prohibition, like its counterpart in Section 5(d)(1), is clearly intended to serve security purposes.

Patent Privileges of Section 7 License Holders

Holders of licenses under Section 7 are automatically entitled to the use of any patent declared by the Commission under Section 11(c)(1) to be affected with a public interest. A patent is declared so affected if the invention or discovery it covers utilizes or is deter-

mined by the Commission to be essential to the utilization of fissionable material or atomic energy and if its licensing is necessary to effectuate the policies and purposes of the Act. Any person licensed under Section 7 may use any patent so classified in carrying out activities under his license. This provision is analyzed in detail in Chapter 8. Here it is sufficient to say that it guarantees that no patent in any area of the economy will be allowed to obstruct the development of atomic energy.

Congressional Review of Licensing Policy

Congress launched the Commission on an uncharted course with only the vaguest indications of the direction to be followed. In the performance of its duties relating to the licensing of industrial and commercial applications of atomic energy, however, the Commission is required to seek both presidential and Congressional guidance before it makes any major move. The Act requires that whenever the Commission decides that the development of any industrial or commercial use of atomic energy has reached a stage of practical utility, it shall prepare a report on the matter for the President, who will in turn transmit the report together with his recommendations to Congress. Congress is given ninety days in which to consider the proposal, after which, in the absence of adverse action, the Commission is free to license.

This is doubtless the most effective provision that could have been framed under the circumstances. It compensates for the lack of specific standards in the Act governing the issuance of licenses; it subjects proposed licensing operations to thorough examination and guarantees full opportunity for discussion of the issues; it gives assurance that the policy of the Commission will be integrated with administration policy; it leaves initiative with the Commission and requires a positive act on the part of Congress—not mere obstructionism—to prevent the Commission from effectuating its program.

The logic of the device chosen becomes all the more apparent when possible alternatives are considered. First, the Commission might have been left free to issue licenses as it saw fit, with only

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The logic of the device chosen becomes all the more apparent when possible alternatives are considered. First, the Commission might have been left free to issue licenses as it saw fit, with only

the very general policy statement of the Act for guidance. This would have entrusted the Commission with sweeping powers over the whole economy such as no democracy would be willing to entrust to appointive officials and would have placed the Commission in an intolerably exposed position politically. Second, Congress might have reserved to itself the exclusive right to decide on licenses and have prohibited any industrial uses without prior legislative authorization. This would have left the way open for all the tactics of obstructionism and delay in which special interest groups are so expert and might thereby have delayed the constructive development of atomic energy by many years. Or, finally, the Commission itself might have been given a monopoly over all operations involving the use of atomic energy, just as it received one over the production of fissionable material. The result of this provision would have been to embark on a steadily expanding program of socialization that by degrees might have assimilated a large part of the total economy. Regardless of the substantive merits of such a program, it will be agreed that an act for the domestic control of atomic energy is not an appropriate instrument for its achievement.

The device adopted is not without precedent in the establishment of administrative agencies. In the Surplus Property Act of 1944 * Congress incorporated a very similar provision designed to accomplish the same general purpose. Section 19 of this Act required that, before disposing of certain types of government-owned installations, the Surplus Property Board should submit to Congress a report describing the property in question, outlining the economic problems that might be created by disposition of the property, and setting forth a disposal program. No action could be taken pursuant to this report until thirty days after it had been submitted to Congress. As a matter of practice the Senate Surplus Property Subcommittee held open hearings on most of these reports upon their submission, and the Board and its successor, the Surplus Property Administration, worked in close cooperation with the Committee. On more than one occasion the sale of a particular type of surplus property was

* 50 U.S.C., § 1628.

held up informally in response to a request from the Committee while the decision was reached as to whether a special bill governing its disposition should be submitted to Congress.

Presumably the reporting function of the Commission will be much the same as that of the Surplus Property Board and its relations with the Joint Committee on Atomic Energy may prove to be very similar to those of the Board with Senator O'Mahoney's Surplus Property Subcommittee. The continuing existence of the Joint Committee should simplify the Commission's task in this field, assuring it a continuing contact with Congressional thought and providing it with a friendly legislative liaison. As a matter of practice the Commission maintains close contacts with Committee members, keeps them informed of developments and plans, and will, no doubt, consult with them concerning policy recommendations in the licensing reports.

Preparation of Reports

The nature of the reports is fairly specifically indicated in the Act:

> Whenever in its opinion any industrial, commercial, or other non-military use of fissionable material or atomic energy has been sufficiently developed to be of practical value, the Commission shall prepare a report to the President stating all the facts with respect to such use, the Commission's estimate of the social, political, economic, and international effects of such use, and the Commission's recommendation for necessary or desirable supplemental legislation. The President shall then transmit this report to the Congress together with his recommendations. . . [Section 7(b)].

The terms of this paragraph are largely self-explanatory. Here we find a formal recognition of the fact that applications of atomic energy are likely to have enormous consequences for the economic, political, and social structure of the nation; an indication that the full resources of science and social science will be mobilized in an effort to foresee these developments before they occur; an acknowledgment that the President must have general supervisory authority

over the policy of the Commission in this field; and an assertion of the principle of ultimate Congressional responsibility for decisions that will be fundamentally political in nature.

The Commission, it will be noted, makes its report on the contemplated licensing of some peacetime use of atomic energy to the President. It is apparent that the policy of the Commission on these matters should be consistent with that of the administration as a whole. Although the terms of this provision merely assure the right of presidential review and comment on the Commission's report prior to its submission to Congress, as a matter of practice the report itself should represent an integrated administration policy when it is submitted. This will usually be assured—except during a period when the Commission members are holdovers from a previous regime—by normal administrative practice. That is, during the formulation of the report the interested agencies will be consulted and differences of opinion reconciled so far as possible. The provision establishing the Military Liaison Committee assures this procedure so far as the military departments are concerned. In the event a fundamental difference should develop, the matter will be referred to the President for resolution. The effectiveness of his intervention and his ability to formulate a policy that will be loyally supported by his entire administration will depend on his personal prestige and the efficiency of the staff work performed for him. (It may be observed parenthetically that the possibility of divided counsels within the administration on such a matter points up the necessity for effective presidential removal power over the Commission as discussed in Chapter 2. The policies recommended under this provision will be characteristically political, and it would be an intolerable situation if one agency within the administration made it a practice to recommend policies fundamentally at variance with those to which the administration as a whole was committed.) Under ordinary circumstances, therefore, it may be assumed that the reports of the Commission will be drafted as administration measures; when they reach the President they will have been cleared by all the agencies concerned, and he will no doubt merely note his concurrence with the recommendations in the report before passing it on to Congress.

The initial problem in drafting such a report will be the definition of its scope. Clearly, it was not the intent of the Act to require Congressional concurrence on each individual license granted by the Commission but rather to assure a general review of each major *type* of industrial or commercial use of atomic energy that the Commission contemplated licensing. The report, then, will have to delimit as specifically as possible the area in which the Commission conceives it is seeking a mandate to act. This area should be so defined that subsequent applications that differ in detail but utilize the same principle and do not promise to have a different kind or magnitude of economic, social, or political effect need not be separately submitted to Congressional scrutiny. Presumably, close cooperation between the Commission and the Joint Committee will avoid difficulties on this point.

In meeting the requirement that it report on "all the facts" in respect to the contemplated use, the Commission will of course have to apply the standard of relevancy. It may well be that certain types of data relevant in one case will not be so in another. Among the elements that will probably always be relevant are the question of the significance of the proposed use from the point of view of security; the danger to public health and safety involved and measures planned to counter such danger; an estimate of the quantities of fissionable material that will be required; the amount of government funds invested in the development of the particular application in question; the current level of efficiency in the proposed use and an indication of what developments are expected; the question of whether any sort of government subsidization is anticipated—as the provision of fissionable material at less than cost—the degree of specialized skill that will be required in the operation; the probable number of firms to be licensed and their geographical distribution; the question of whether, because of amounts of fissionable material involved, it will be necessary to limit the number of licenses and, if so, what would be the grounds of preferring some to others.

What makes decisions to license particular types of industrial and commercial uses of atomic energy a political issue is the certainty that the uses will have great economic, political, and social effects.

It was this fact that moved Congress to reserve to itself final judgment in this field. The initiative in determining that the time is appropriate and that the particular use ought to be authorized rests with the Commission. The determination that the development of a specific application has reached a stage justifying its commercial exploitation is almost a question of fact, and the judgment on such a point does not of itself raise controversial issues. But the Commission will also have to make the initial judgment as to the desirability of issuing such licenses on the basis of its prediction of the social, political, economic, and international effects that will flow from the new use. This is an exceedingly difficult task and unless very carefully performed may seriously discredit the Commission.

Let us consider what compliance with the language of the Act will involve. In reporting on the economic effects the Commission will have to assess the competitive worth of the process and estimate the extent of its initial application, the speed with which it will be adopted by new licensees, the amount of capital investment that will be made in new plant, and the extent of new employment likely to result. It will need to assess the effects of the program of capital expansion on industries supplying basic materials required and to consider the effects of developments in this field on competitive industries—the value of their capital investments and the number of workers employed. All these factors will then have to be weighed together and an over-all judgment made as to effects on the general level of business activity and the trade cycle. In reporting on social effects the Commission will have to consider such factors as possible changes in the geographical distribution of industries and population, the demography of cities, and the conditions of labor. Under political effects would fall the changes in national, state, and local laws, ordinances required to deal with changed economic and social conditions, and consequent changes in administrative organizations and personnel that would be required. Under international effects the Commission would have to report on probable foreign interpretations of the military significance of the proposed use, its relation to existing systems of international control of atomic energy, and the problems it would pose for an international inspection authority.

Merely to enumerate the elements in this partial list gives an impression of the formidable nature of the assignment imposed upon the Commission by this provision. It calls for a brilliance of prognosis that has been occasionally demonstrated by the most gifted of political philosophers and perhaps by a few of the Royal Commissions in the United Kingdom but has hardly been characteristic of the routine reporting of administrative agencies. Perhaps the simplest manner of demonstrating the difficulty of this reporting assignment is to imagine what predictions would have been included in a report written in 1900 on the social, political, and economic effects of the utilization of the internal combustion engine in the motorcar. What would the most learned of our economists have had to say about the number of cars that would ultimately be built—the quantities of basic materials consumed and investment and employment in the manufacturing industry, dealers' establishments, and garages—about the expansion in the petroleum and tire industries and their distributing outlets; about the amount of highway and bridge construction and the consumption of basic materials involved; about the total effect of these primary and secondary factors on providing employment and maintaining an expanding economy? What would have been the estimate of the effects of the motorcar industry on railroads and railroad investments; on the distribution of population; on the structure of cities? What would have been said about the motorcar as a formative influence on social customs; as a mark of social status and an example of conspicuous consumption; as a contributing factor toward installment buying? What would have been the assessment of its effect on the divorce rate, on juvenile delinquency, on crime, and on the expansion of federal criminal-enforcement agencies?

Certainly, the reports of the Commission on the effects of uses of atomic energy should be somewhat more perceptive than any conceivable report written fifty years ago on the motorcar. There have been advances in the techniques of the social sciences and in our capacity to organize varied skills to produce a prognosis of the type required. Nevertheless, the best of these reports will be hedged with qualifications and full of alternative hypotheses. The

Commission will doubtless arrange for the collaboration of the best minds in science and the social sciences in the writing of its reports, employing for each assignment whatever consultants are best qualified for the particular task. Such a group should be able to draft a report that will point up sharply immediate problems and foreshadow, albeit dimly, probable ultimate trends—that is, most of the effects of the new use during the immediate future, and some of the long-term effects, assuming a constant level of operating efficiency. It is altogether clear that all such estimates diminish sharply in worth when marked and unforeseen developments in operating efficiency occur. Perhaps with the accumulation of experience predictions concerning probable increases in efficiency may be made with some confidence, but the more hypothetical and contingent the judgments on the direct results of scientific advances, the more vague and tenuous must be the estimates of the indirect results. On balance, then, it would be unrealistic to expect too much illumination from these reports of the Commission. Scientific and social changes cannot be accurately foreseen, even by experts, except at close range, and legal and institutional changes to accommodate them must be made gradually, step by step. But the admission of this practical limitation should not be interpreted as belittling the importance of a device that may enable public understanding and legislative forms to keep pace with, rather than, as customary, lag lamely behind, developments in a field that will be marked by flux and change.

Consideration of Reports

The filing of the Committee's report with Congress should be the signal for the arrangement of public hearings, which will no doubt be conducted by the Joint Committee on Atomic Energy.* The report will provide the basis for discussion and its prediction of effects will no doubt be subjected to rigid scrutiny and often to violent criticism. Where important economic interests are at stake, as they often will be, the hearings, one may conjecture, will be sharp with

* The Atomic Energy Commission is also empowered to hold public hearings [Sec. 12(a)(3)]. It may find it desirable to use this device in preparing its reports.

controversy. In the course of these hearings, the issues involved should receive a thorough airing, and the ninety days allowed for Congressional consideration should permit time for the mobilization of all the forces interested. Adroitly handled, such hearings can be made to perform a useful educational function and may serve to point up and define the issues at stake while illuminating the reasons for opposition.

At the end of the hearings, the Committee may table the report and, by reason of the default of Congressional action, the Commission would then be free to proceed with its program; or the Committee may report to the two houses recommending an outright rejection or a modification of the Commission's proposed program. Presumably, either of these objectives could be achieved only by the enactment of a statute, and since positive action by a majority of both houses would be required, there would be small possibility of quietly killing a proposal by obstruction and delay. For once, the power to obstruct would be on the side of those who supported the innovating program of the Commission rather than on the side of those who wished to maintain the status quo.

By-product Power

The only industrial use not subjected to the reporting procedure is the harnessing of by-product power generated in the manufacture of fissionable material. The Act makes specific provision for the sale of such power in Section 7(d):

> If energy which may be utilized is produced in the production of fissionable material, such energy may be used by the Commission, transferred to other Government agencies, or sold to public or private utilities under contracts providing for reasonable resale prices.

Although this should enable the Commission to deal adequately with by-product power, the provision is so much less specific than most federal power legislation that it may prove desirable to amend and expand it when such power can at last be produced on a substantial scale.

8. Patents and Inventions

The best public measures are seldom adopted from previous wisdom but forced by the occasion.

Benjamin Franklin, *Autobiography,* 1798.

In the patent section of the Act (Section 11) two basic concepts, each regarded as fundamental to our system, collided head on. These concepts were security, as we had with some dismay begun to understand the term in the beginning of the atomic age, and the institution of private property, as expressed here in the hallowed forms of the patent system. The conflict between these irreconcilables was reflected in the debate over most of the major provisions of the Act, as we have already pointed out, but nowhere was it so clearly defined and so bitter as in the struggle over the subject of patent provisions.

The simple expedient whereby during the war private patent applications involving the national security were kept secret by the Commissioner of Patents provided only a partial solution. This action was authorized by an act of Congress * passed during World War I that empowered the Commissioner to keep certain inventions secret and withhold the issuance of certain patents in *wartime.* Although this power was broadened in 1940 † to authorize the Commissioner to withhold the issuance of patents of military value for such periods as he might determine, presumably the act of 1940 extends only to applications *filed during wartime.* Thus patent applications on military devices filed after the end of the war would not be covered; nor would the statute ‡ under which atomic energy inventions were handled during the war prove helpful since that law is limited to government-owned inventions. In any event all these

* 35 U.S.C. § 42, 40 Stat. 394.
† 35 U.S.C. § 42, 54 Stat. 710.
‡ 35 U.S.C. § 37.

techniques merely postponed issuance of the patent; none contemplated control of the patent after issuance.

The very nature of the patent system requires the disclosure in detail of the device or process to be patented. In the patent application there must be a description of the invention, its manufacture, and its use "in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected . . ." to duplicate it. Thus, if a new device for producing fissionable material were patentable, the patent application would of necessity recite every relevant detail, the patent would be published, and all information contained in it would be public. The alternative to this procedure, vaguely advocated by those who objected to the provisions actually incorporated in the Act, was to establish a category of permanently secret patents. This concept is so obviously absurd—one need only imagine the confusion that would be generated whenever "secret" patents became the subject of litigation—that it never received serious consideration in Congress. The issue was clearly defined and could not be compromised. Congress had to decide whether to protect property rights embodied in patents at the expense of national security or to protect national security at the expense of patent rights.

The House of Representatives was so stalwart in its defense of property rights that at one stage in its deliberations it adopted, as substitute for the patent provisions passed by the Senate, a series of extraordinary provisions prepared by the then ranking majority member of the Patents Committee of the House. This substitute omitted any reference whatever to the need for secrecy in certain types of atomic energy devices, and created no machinery to provide it. This ready willingness to waive the need for secrecy where it impinged on the institution of private property provides an interesting contract to the zeal with which the House voted the death penalty for unauthorized dissemination of "restricted data." The House had perhaps been impressed by the example set by the officials of the Manhattan District.

Seldom have the military guardians of our national security so convincingly demonstrated their wholehearted and uncritical loyalty

to the institutions of our system as in their devoted adherence to the ritualism of patent procedures during the development of the atomic bomb. A brief but impressive demonstration of this loyalty is provided in the testimony before the Senate Special Committee of one Captain Robert A. Lavender, USN, Retired, Chief Patent Adviser to the Office of Scientific Research and Development. Captain Lavender, having revealed that there were patents on file covering every detail of atomic energy development, immediately soothed the fears of the Senators by assuring them that these patents had had "special handling," that no more than a few people were acquainted with their contents, and that the patents were kept "in separate safes" in the Patent Office. The Senators were particularly perturbed as to the status of the data on the atomic bomb itself. Captain Lavender reassured the Committee that the economy was safe, that infringement suits against the government need not be feared, "that the bombs are covered by applications." But the Chairman, Senator McMahon, persisted in his puzzlement. "I wonder," he asked, "what is the necessity for covering the bomb itself by applications for patents?" Captain Lavender replied cogently, "Well, it is very important for this reason: I knew that as soon as the bomb went off there would be a great deal of speculation among various scientists and other engineers, who had not been connected with the project. I knew that a great many applications would be filed in the Patent Office, so I was interested in having filed in the Patent Office these applications, so that if any applications were filed and we got into interference, the government would not be suffering the handicap of being the second one to file, because the first to file has a great advantage from an interference procedure point of view." *

Neither the Chairman nor Senator Millikin felt that this entirely met the causes of their disquiet, nor did Captain Lavender's disclosure of "another special handling," a kind of special, special handling, for atomic bomb applications convince the Committee that the secrets had been as zealously guarded as the government's legal

* Atomic Energy Act of 1946 Hearings before the Special Committee on Atomic Energy, United States Senate, Seventy-ninth Congress, Second Session, on S.1717, Part 3, p. 347 *et seq.*

rights. However, there can be little doubt that any private person who built an atomic bomb would be infringing on the property of the people of the United States and liable to a civil suit.

In the end, the Senate provisions were accepted and the patent section as enacted emerged radical and untempered. While taking meticulous care that no property rights should be modified without adequate compensation and that future discoveries and inventions should be suitably rewarded, Section 11 revokes all patent rights, present and future, that might endanger the security of the country or interfere in any manner with the full development of atomic energy, both in its military and nonmilitary applications. Where the privileges of the patent system seemed to hold a threat to the national security, they were altogether abandoned. Where there was doubt that patents issued in the field of atomic energy would serve as a spur to inventive genius and contribute to development and a possibility that such patents might be used to stifle development or strengthen monopolistic practices, the system was modified. The resulting provisions make a unique pattern among American institutions. All patents are abolished in certain areas monopolized by the government and sweeping government control is established in all other parts of the general field. The Commission, under the policy directives of the Act, is required to use these powers to promote private enterprise, to develop and utilize atomic energy, and to strengthen free competition. Coupled with these policy objectives, Section 11 can be interpreted as a recognition of the fact that, as it normally operates, the patent system does not inevitably generate these results and that, if they are to be realized, at least in the field of atomic energy, powerful and continuing assistance may be required.

The opinion has already been expressed that the control system is complicated because the Act distinguishes sharply among the types of activities in the field of atomic energy and attempts to apply to each activity a control no more drastic than its character requires. To recapitulate briefly, the major divisions of activity in the field of atomic energy were established as follows: transactions involving source material; the manufacture of devices for the production of

RELATION BETWEEN LICENSING AND PATENT PROVISIONS APPLICABLE TO DEVICES

Category	*Definition; subcategories*	*Manufacture and/or use*	*Patents*
I. Production devices for fissionable material	I 1. Production facilities proper (probably essential devices) *a.* Useful solely for this purpose *b.* Multiple use 2. Devices used in production, but not production facilities proper *a.* Useful solely for this purpose *b.* Multiple use	I. 1. *a.* Manufacture by licensees only; use controlled by limitations on production of fissionable material *b.* Manufacture by licensees only; no restriction on nonatomic energy uses * 2. *a.* No restriction on manufacture; use controlled by limitations on production of fissionable material *b.* No restriction on manufacture or nonatomic energy uses	I. 1. *a.* Revoked in full [11(a)(1)] *b.* Revoked with respect to atomic energy uses† [11(a)(2)] 2. *a.* Revoked in full [11(a)(1)] *b.* Revoked with respect to atomic energy uses† [11(a)(2)]
II. Military devices utilizing fissionable material or atomic energy	II. 1. Military weapons (probably confined to finished weapons or essential components) *a.* Useful solely for this purpose *b.* Multiple use 2. Devices used in utilization of fissionable material or atomic energy for military weapons, but not weapons proper	II. 1. *a.* Manufacture with Commission permission only; use by government *b.* Manufacture with Commission permission only 2. *a.* No restrictions on manufacture; use by licensees only *b.* No restriction on manufacture or nonatomic energy uses	II. 1. *a.* Revoked in full [11(a)(1)] *b.* Revoked with respect to atomic energy uses† [11(a)(2)] 2. *a.* Revoked in full [11(a)(1)] *b.* Revoked with respect to atomic energy uses† [11(a)(2)]

fissionable material; the production of fissionable material; the production of military weapons utilizing fissionable material or atomic energy; the utilization of fissionable material or atomic energy for medical therapy; the utilization of fissionable material and atomic energy for commercial and industrial purposes; research and development on any of the above, as well as in nuclear processes and the theory of atomic energy. The breakdown of functions for purposes of the system of patent controls is somewhat less complex, but the categories established roughly parallel those of the general control system. Together, the patent provisions and controls serve as integral parts of one general system, as will be seen in the chart on pages 146 and 147, which summarizes much of the material in this chapter.

Devices: Production of Fissionable Material, and Military Weapons

Single-use Devices

The Act prohibits the patenting of any invention that is "useful solely in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon" [Section 11(a)(1)]. Patents of this description, now in force, are expressly revoked with the proviso that "just compensation shall be made therefor." Here, as in the establishment of a production monopoly for fissionable material and of information controls, there is clearly shown the determination of Congress to preserve at any cost the safeguards deemed necessary for national security. In this instance the subject matter to be safeguarded is the data of nuclear physics and nuclear engineering. Only by removing from the normal routine of the patent system inventions and discoveries incorporating such data can the information be kept, even briefly, in a restricted status.

While the scope of this section seems extremely sweeping, its practical implications should not be exaggerated. Under other provisions of the Act the inventor of a production device could not,

were he able to secure a patent, either manufacture the device without a license from the Commission, or utilize the invention himself, or license its use to anyone other than the government. Since he is assured of a reward commensurate with the novelty, utility, and importance of his invention under the compensation provisions, the denial of patent rights should for him have little more than semantic significance. This is particularly true, since under an existing statute * the inventor of a device desired by the government for its own use can neither withhold it from the government nor even fix the royalty, which is determined by the Court of Claims.

Similar principles hold for devices useful solely in the utilization of fissionable material or atomic energy for a military weapon. The device cannot be manufactured except with express authorization of the Commission; the government alone is authorized to use an atomic energy weapon; adequate compensation will be paid to the inventor for any useful military device. Under these circumstances, to deny the inventor patent rights is to deprive him of nothing of practical value.

The foregoing discussion has been confined to the inventions and discoveries of the future. Many private patents, embracing devices and processes basic to the production and use of fissionable material, were, however, granted before the adoption of the Atomic Energy Act. According to testimony before the Senate Special Committee, all of the principal inventions for which applications were filed were assigned to the government. Whether or not the public interest in this project, financed entirely at public expense, was in fact so scrupulously served is known for certain only to that select fraternity that was made cognizant of the contents of Captain Lavender's "separate safes" at the Patent Office. In any event, all outstanding private patents are automatically revoked by this subsection and whether any claims are filed with the Commission for compensation will constitute the best evidence on the subject.

How is a manufacturer (and patent owner) of a presently existing device for the production of fissionable material (or for its utilization in a military weapon) affected? To begin with, it should be

* 35 U.S.C. § 68.

recalled that the manufacturer of a production facility (or an atomic weapon) cannot continue such manufacture without a license from the Commission. If he receives a license, he may continue to produce the device for the use of the Commission even though his patent rights are revoked. Revocation of the patent rights, however, permits the Commission at its discretion to license other manufacturers to produce the same device. Presumably, in determining the compensation to be awarded to the patentee, the number of such licenses will be considered. In other words, the amount of royalties the inventor could have earned by licensing or otherwise, had his patent not been revoked by this subsection, is the main factor to be weighed in fixing his compensation.

Multiple-use Devices

The treatment under the Act of inventions useful *solely* in the production of fissionable material or military weapons is a relatively straightforward matter. Inventions with multiple uses—*i.e.*, useful both in the field of atomic energy and in other fields—present a more difficult problem. Section 11(a)(2) revokes every patent on an invention or discovery of multiple use "*to the extent that* such invention or discovery is used in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon" (italics by authors). Just compensation is also required for patents partly revoked pursuant to this section.

Complicated problems will certainly arise in determining when a device is "used in" the production of fissionable material. Do the words refer to devices actually "used in," or devices which "could be used in" such production? The subsection in question contains no qualifying language and may be construed to cover every possible tool, machine, process, etc., that is or could be used to keep the Oak Ridge or Hanford installations in operation. The device need not be "specially designed" [*cf.* components of production facilities, Section 18(g)]; it need not be "peculiarly adapted" [*cf.* utilization equipment, Section 18(f)]; it need not be "essential" for the production of fissionable material [*cf.* condemnation authority, Section

11(d)]. Whether the patent covers a stepladder, a hammer, a pump, an electrical transformer, a cyclotron, a chemical process, or an industrial design for supporting concrete flooring; whether or not the device (or process) is peculiarly useful or essential in the production of fissionable material—all of these factors are immaterial if the device is used in such production.

Here again, its possible scope is a poor guide to the section's practical implications. Consider the case of high-vacuum pumps. These pumps, useful in certain phases of isotope separation, are also useful in other industrial processes. As sole producer of fissionable material, the Commission will probably buy the pumps rather than make its own. Most likely it will procure them from the patentee or one of his licensees. But since patent rights in the pump are revoked insofar as they are employed in the production of fissionable material, the Commission may purchase pumps from other manufacturers licensed by it. Research institutions in this field may also buy pumps from any manufacturers holding licenses issued by the Commission. Unless the Commission grants a license under Section 4(e), no manufacturer may take advantage of the partial patent revocation. As a matter of practice the Commission will probably do so only when there is a real object to be gained thereby. The determination of just compensation in cases involving partial revocation is likely to prove difficult and vexatious, and the Commission will hardly undertake, without reason, to buy from a manufacturer who is not already authorized under the patent.

Devices Used in Research

In the treatment of patents there is accorded to research the same status of privilege that it enjoys throughout the Atomic Energy Act. Section 11(b) emancipates from the scope of the patent system "any invention or discovery to the extent that such invention or discovery is used in the conduct of research or development activities in the fields specified in Section 3." This section, it will be recalled, embraces all research in nuclear science and the many fields—medicine, engineering, chemistry—applying the knowledge gained through nuclear studies. Existing patents are revoked "to the extent" the

inventions they cover are used in research; patents "granted hereafter" confer no rights as regards use in research; just compensation is to be made for every partial revocation of an existing patent.

The general purposes of this section are three: one, to permit the use of apparatus in the conduct of research free of patent restrictions and characteristic patent abuses; two, to permit research workers to construct their own apparatus without fear of infringing on existing patents and without being forced to seek licenses or pay royalties; three, to encourage, or at least to remove obstacles to, the improvement of existing scientific apparatus by rendering less profitable the expedient of suppressing inventions.

To clarify the meaning of this subsection it will be necessary to consider two types of devices: those that fall unambiguously in the class of scientific instruments, useful solely for research; and those that are used in experimental work but serve other purposes as well.

The cyclotron may be taken as an example of the class of scientific instruments useful solely in nuclear research. Assume that A holds patents on a certain type of cyclotron and manufactures it for commercial distribution. It is not to be inferred that the patents held by A are automatically revoked, as they would be if the device that they covered were, for example, useful solely in the production of fissionable material. The patentee retains the exclusive right to make, sell, or use the cyclotron for any purpose other than atomic research. But there is a partial revocation of A's patents with the following consequences:

1. It is permissible to make * a replica of A's product for use in one's own research without infringing A's patents.

2. It is permissible to make a replica of A's product or to purchase one of his cyclotrons for the purpose of redesigning or improving the instrument itself. In other words, A's cyclotron may be used as an object of research, as distinguished from a tool in the course of research, and this activity also may be conducted in-

* The Act reads, "To the extent that such invention or discovery is used in the conduct of research." Strictly, "use" may be distinguished from "make," but the intent to free atomic research from a patent owner's unwillingness to make or sell his invention would be thwarted if this interpretation were not adopted.

dependently of A's patent rights. It should be noted that under the well-established legal doctrine of "experimental use," the reproduction of a patented device for the purpose of experimenting on the device itself is not deemed a patent infringement. But judicial decisions in such cases are neither uniform in reasoning nor consistent in result, particularly in actions for patent infringement where the defendant was found to be experimenting with a "commercial incentive." Such crevices of uncertainty seem to be sealed by the language of the Atomic Energy Act. Since Subsection 3(a)(2) provides for research on "processes" and "devices" and since the present Subsection 11(b) covers the use of inventions in the course of the research described in Section 3, there can be no doubt that the "incentives" of the research worker have no bearing on his exemption from patent restrictions.

3. It is not permissible either to manufacture or to sell a replica of A's product to a person who will use it in research, even nuclear research.

There remains for examination the class of multi-use devices in the field of nuclear research. Here again, the principles noted with respect to multi-use devices in production and in military weapons apply. Consider, for example, the case of a manufacturer of a patented electrical transformer that, in addition to certain industrial uses, is valuable for research in the chemistry of plutonium. So far as this provision is concerned, he continues to hold his patent rights against all users except those using the transformer in the course of nuclear research.

Compensation, it will be noted, is provided only for partial revocation of *existing patents*. Future patents confer no rights with respect to inventions used in the conduct of research. Determination of such compensation is not likely to prove too troublesome. While scientists may build their own apparatus, in practice they, or the institutions with which they are affiliated, will probably continue to purchase the instruments needed for research from the manufacturer, who in turn is the patent owner or a licensee. With compensa-

tion dependent on "actual use" [Section 11(e)(3)(B)], neither the volume of cases nor the size of awards is apt to be substantial.*

It should be remarked, however, that the term "development" is broader than research, including, as defined in the Act [Section 18(e)], the extension of investigative findings and theories "into practical application for experimental and demonstration purposes." The use of inventions in the conduct of research and development, free of patent rights, means something more than the occasional scientist tinkering or building his own tools in the laboratory. It means that industrial laboratories engaged in large-scale nuclear research—*e.g.*, the production of atomic power—can build all their facilities and apparatus without regard to outstanding patents. This may require substantial "partial revocation" awards to holders of patents existing at the time the Act went into effect.

Nonproduction and Nonmilitary Devices

In treating patents on devices of significance in the field of atomic energy other than production of military devices, Congress sought to preserve the basic right to patent while eliminating the more glaring abuses that have come to mark the system.

Such devices may be of two kinds: (1) they may utilize fissionable material or atomic energy, for industrial, commercial, therapeutic, or other purposes; or (2) they may be altogether outside the field of atomic energy and yet nevertheless essential to the utilization of fissionable material or atomic energy. For the sake of convenience we shall hereafter refer to devices of the first sort as "ordinary atomic energy devices," and to those of the second as "ancillary devices." †

Manufacture of the ordinary atomic energy device will require a

* One may note that if patented devices are purchased from an unlicensed manufacturer, even though they are to be used in research, both the manufacture and sale constitute infringements of existing patents.

† It is impossible for a layman to say with any certainty just what an ordinary atomic energy device might be. The reader is at liberty to conjure up his own private marvels, but to give aid to those whose imaginations do not respond immediately to this stimulus, we suggest as a plausible device a small reactor, burning nuclear fuel, which would be used to propel a ship.

license issued by the Commission pursuant to the provisions of Section 7 of the Act.

But the Act requires of the Commission an interest in the ordinary device that extends greatly beyond the mere licensing of its production. It is charged with the carrying out of a declared policy that will assure that "the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise. . . ." [Section 1(a)]; it is required to administer "a program for Government control of the production, ownership, and use of fissionable material . . . to insure the broadest possible exploitation of the fields" [Section 1(b)(4)]. To effect these policies, the Commission will need to maintain a firm and continuing supervision over ordinary atomic energy devices and to make certain that patents on devices essential to the utilization of atomic energy shall not be permitted to obstruct developments.

When the patent application on the ordinary device is filed, the Patent Office must notify the Commission. In the case of ancillary devices, the probability is that the initiative in securing a declaration that a patent is affected with a public interest will be taken by some licensee who finds that his operations are being hampered by his inability to use the device in question. In any case, the Patent Commissioner is required to provide the Commission access to applications filed. The Commission may, if it thinks the situation warrants, declare a patent in either category—that is, covering an ordinary atomic energy device or an ancillary device—"*affected with the public interest.*" The making of this declaration has the following effects [Section 11(c)(2)]:

1. The Commission is automatically licensed to use the device covered by the patent "in performing any of its powers under this Act."

2. Any person to whom a license has been issued under Section 7 is authorized to use the patent declared so affected to the extent the invention it covers "is used by him in carrying on the activities authorized by his license under Section 7."

What circumstances make it the "duty of the Commission to declare any patent to be affected with the public interest"? Section 11(c)(1) sets forth these criteria: (1) "the invention or discovery covered by the patent utilizes or is essential in the utilization of fissionable material or atomic energy"; and (2) the licensing of the invention or discovery under this subsection "is necessary to effectuate the policies and purposes" of the Act.

Any invention that is covered by the definition of an "ordinary atomic energy device" meets the first condition. But an ancillary device that does not utilize fissionable material may also be included so long as it is "essential" in such utilization. What is "essential"? Presumably, a device or component indispensable to the functioning of some other device that utilizes atomic energy. In medieval times a kingdom was allegedly lost for want of a nail; in our interdependent technology a gigantic war machine almost came to a halt because of a shortage of special one-inch aircraft screws.* In the air war against Germany the planners agreed that ball bearings were essential to the whole war economy and that ball-bearing plants must have first priority as targets. These examples are cited to show that "essential," as used in the text, is essentially undefinable. It is likely that the Commission must first decide whether the licensing of an invention "is necessary to effectuate the policies and purposes of this Act"—the second condition, to which we shall turn in a moment—and, if this is decided affirmatively, then determine whether the invention is actually "essential." On occasion it may be necessary to adopt the tactics of Procrustes.

As for the second condition—that the licensing of an invention must be found "necessary to effectuate the policies and purposes of the Act"—this seems to confer upon the Commission a very broad discretion. It is clearly designed to empower the Commission, on broad social or economic grounds, to liberate any or all devices needed in the development of atomic energy from the coils of the patent system.

* Jack and Heinz, Precision Industries, Inc., Cleveland, Ohio, were the manufacturers of these screws indispensable in the construction of fuselages and frames. The case was a bottleneck *célèbre* in the early days of the war.

This section confers on the Commission sweeping powers to avoid and remove obstacles to the positive development of atomic energy in accordance with the constructive purposes of the Act. There is, however, one gaping omission that must be attributed to a flaw in draftsmanship: this is the failure to make any provision whereby the benefits of atomic energy developments in medical therapy can be made freely available. In their anxiety to provide the maximum freedom for medical use of atomic energy, the legislative draftsmen exempted this category from the licensing provisions of Section 7. In drafting Subsection 11(c) they provided that all patents declared affected with the public interest might be used by any person holding a license under Section 7. This exclusion of medical therapy was corrected nowhere else. Thus, we have the interesting result that the use of a patent to extort unreasonable profits in, say, the utilization of an atomic energy battery is effectively prevented, but the inventor of an atomic energy device, useful in the treatment of cancer, is free to patent the device and make such charges for it as the traffic will bear. If abuses develop in this field, the Commission should certainly recommend that the flaw be remedied by legislative amendment.

The powers of the Commission derived from Subsection 11(c) must be regarded in conjunction with its licensing powers under Section 7. Together, they form a single instrument of single purpose; namely, to promote the usefulness of atomic energy in the public interest. Materials, facilities, and scientific man power are all limited. Within the bounds of its authority, the Commission must, in effect, allocate resources to meet competing requirements. A system of priorities based on a policy reflecting the principal objectives of the Act must govern the allocations. The authority to license the manufacture of atomic energy devices is an integral part of any allocation policy. The complement of this authority is the authority to compel the licensing (and to fix royalties) of patents covering devices needed for such manufacture.

Without this compulsory licensing provision the holder of a patent on an ordinary atomic energy device or an ancillary device might be in a position to prevent altogether the manufacture of some

device, or even a number of devices, duly licensed by the Commission under Section 7. For the patented device might be an essential component of the other, and if the patent holder refused to license the use of his device or demanded excessive royalties, the manufacturer licensed under Section 7 could get no relief. Thus the owner of a patent covering a device uniquely essential to the manufacture of several types of atomic energy devices could dominate the industry by the appropriate manipulation of his licensing power.

Compulsory licensing does not represent a startling innovation in the patent system of capitalist countries. Statutes incorporating such a principle have been in force in the United Kingdom since 1883,* and a similar Act has been repeatedly urged in the United States during the past half century.

Proposals for compulsory licensing in the United States, however, have always been most bitterly opposed by the beneficiaries of the present system, since to remove the power to strangle competition is to diminish considerably the economic significance of patents. In the discussions of the patent section of the Atomic Energy Act in Congress, the compulsory licensing feature was the object of the most vehement attacks, some of them bordering on hysteria. A former assistant patent commissioner warned the House Military Affairs Committee that the patent section of the Act was copied directly from the constitution of the USSR with minor changes to allow for the difference in idiom. The sensation created by this revelation was only slightly mitigated by the fact that the provision had been drafted by an eleven-man, blue-ribbon Senate Committee and had been adopted unanimously by the United States Senate.

Procedures for Reporting Production Devices and Military Weapon Devices

With certain vital areas of nuclear technology in the nonpatentable zone, the Commission instead of the Patent Office becomes the central agency to which inventors operating in these areas apply. Section 11(a)(3) covers the point adequately as follows:

* Patents, Designs and Trade Marks Act 46 & 47 Vict. c. 57, § 22 (1883).

1. Any inventor or discoverer of a device or process useful in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon must file with the Commission within a specified time a detailed description of the device or process.

2. The time specified is sixty days after the enactment of the Act (September 30, 1946) in the case of inventions and discoveries previously made and, in the case of new inventions or discoveries not later than the sixtieth day after such invention or discovery. This completion date is unavoidably a vague concept, and the Commission will probably be required to interpret it afresh in each new case arising under this subsection. The essential consideration should be the good faith of the inventor in reporting his accomplishment as soon as he has reason to believe it workable and useful. The Commission's general inspecting activities in the field of atomic energy projects and its authority to require periodic reports should considerably simplify the enforcement problem in this field.

Since nuclear research and engineering is a new field, largely shrouded by security regulations, it may be expected that for some time to come inventions or discoveries will be made that will have significance for the production of fissionable material or for its utilization for a military weapon without the inventor being aware of the fact. In order to provide for this possibility, Subsection 11(a)(3)(c) authorizes the inventor unaware of the significance of his invention to file application for a patent in the usual way or, in the event he has not made such application, to file a report within sixty days after he first discovers or has reason to believe that his invention falls into the category established by this subsection.

Great skill will be needed for the effective enforcement of the provisions of this subsection. The Commission must have prompt and detailed reports on all new developments in atomic energy in order to conduct its production and research programs, and it cannot assume that the provisions cited will automatically produce this result. The willing cooperation of the inventor must be enlisted, otherwise he can pretend that the invention is not yet "completed,"

or that he is unaware of its importance to atomic energy. Everything possible must be done by the Commission to correct the misapprehension willfully cultivated by some of the opponents to the patent section of the effect of these provisions and to demonstrate that the Act neither destroys the patent system nor takes away the inventor's property without compensation. The examination of reports on new inventions and the making of compensatory awards where the usefulness of the invention justifies compensation should be accomplished with a minimum of "bureaucratic" delay. If it becomes recognized that the efficiency of the Commission in processing reports compares favorably with analogous procedures performed by the Commissioner of Patents and that the compensation awarded inventors is based on a fair, consistent, and comprehensive policy, cooperation will be readily forthcoming. Admittedly, the determination of awards will be among the most difficult functions to be performed by the Commission; but this is merely to say that the task merits extraordinary effort.

Compulsory Licensing and Royalties

The Commission has authority to compel the licensing of patents and thereby it can check the growth of monopoly and encourage competition in this new field. A provision for compulsory licensing requires a provision controlling royalties to complement it; for otherwise the patent holder could peg royalties at a prohibitive rate.

The Act meets this point by providing that "the owner of the patent shall be entitled to a reasonable royalty fee," which may be agreed upon by the owner and the licensee (under Section 7). But if they are unable to reach an agreement the royalty rate shall be determined by the Commission [Section 11(c)(2)].

Supplementary support for the compulsory licensing and royalty fixing mechanism is provided in Section 11(c)(3). The principal features of this section are as follows:

1. No court may enjoin a licensee, under Section 7, from using a patented invention declared to be affected with the public interest

under Section 11(c)(1). While the licensee is automatically entitled to use such a patented invention, it will be recalled he may do so *only* "to the extent such invention or discovery is used by him in carrying on the activities authorized by his license . . ." Presumably, therefore, if the patented invention is used for purposes outside the scope of the license, a court of competent jurisdiction would *not* be prohibited from issuing an injunction in an action for infringement by the patent holder.

2. Assuming the court finds that the defendant-licensee is actually using the patented device but royalties have neither been agreed upon nor determined by the Commission (this circumstance might arise, either where the licensee was unaware of the existence of a patent on the device used by him or where, in his opinion, he was not actually infringing on the patent), the Court shall "stay the proceeding until the royalty fee is determined pursuant to this section." The measure of damages, once the royalty is so determined, shall be the royalty fee, "together with such costs, interest, and reasonable attorney's fees as may be fixed by the court."

3. Where royalties have been fixed by arrangement between the parties or by the Commission and a licensee then fails to pay, "the patentee may bring an action in any court of competent jurisdiction" for his royalty fee, costs, etc.

Power to Requisition and Condemn Patents

In addition to the patent revocation and compulsory licensing authority, the Commission under Section 11(d) is authorized to purchase, take, requisition, or condemn any invention or discovery useful in the production of fissionable material, useful in the utilization of atomic weapons, or that "utilizes or is essential in the utilization of fissionable material or atomic energy," as well as patents or patent applications covering such inventions or discoveries.

The scope of this authority parallels that of Subsections 11(a) and 11(c). Thus, patents on multiple-use production devices, military weapons, and utilization devices only partially revoked or restricted by the provisions already discussed may be wholly taken

over by the Commission in the exercise of its condemnation power. It is also worth noting that, while medical patents are not subject to compulsory licensing, they are nevertheless subject to condemnation as patents or inventions utilizing fissionable material or atomic energy.

This too is an innovation in governmental powers as regards patents, but it forms a logical supplement to the Commission's general authority in this field. It enables the Commission to deal speedily and effectively with uncooperative patent owners. It provides an instrument that may prove useful in protecting the national security. It is possible, for example, that multiple-use inventions employed in the production of fissionable material or in certain ordinary atomic energy devices might incorporate data that, determined on security grounds, should be restricted. Under its broad acquisition authority the Commission could take over the inventions and patents and safeguard them until the data they incorporated had been removed from the restricted category. Since just compensation must be made in every case and all awards, as will be seen below, are subject to court review, the property rights of patent owners are adequately protected.

The Commissioner of Patents is required to notify the Commission "of all applications for patents heretofore or hereafter filed" that in his opinion disclose an invention or discovery of the type the Commission is empowered to acquire—that is, atomic energy devices of virtually every type. The Commissioner of Patents is also required to provide the Commission access to all such applications. While this provision is essential to the Commission in the discharge of its function of acquiring patents, it is of considerable importance to the performance of certain other functions of the Commission as well. It provides the Commission with an invaluable source of information as to new technological developments, information useful in its research, engineering, and production programs and should be useful as a supplementary check on monopolistic trends and in the enforcement of security controls. At every stage of the development of the applications of atomic energy problems will arise jointly affecting the responsibilities of the Commission and the Patent Office.

It is clear that the cooperation between these two agencies must not be limited to the formalism of the reporting provision of the present section but must be vital, close, and continuous.

COMPENSATION

Eligibility

Applications for compensation for patents wholly or partially revoked or for the establishment of royalty rates are to be considered by a Patent Compensation Board consisting of two or more employees of the Commission. Final determinations are subject to the approval of the Commission. The draftsmen of the Act made an earnest endeavor to set forth, as guides for the Commission, a framework of standards from which a coherent compensation policy might be evolved. Nevertheless, the Commission is certain to find performance of its functions in this area difficult and vexatious.

Before examining these standards it may be useful to list the classes of applicants eligible for awards:

1. The owner of a patent for production of fissionable material or military weapons or covering a device useful in atomic energy research may apply for just compensation [Sections 11(a)(1), 11(a)(2), 11(b)].
2. The owner of patent declared affected with the public interest may apply for the "determination of a reasonable royalty fee" for the use of his patent, or a licensee under Section 7 may apply for the same purpose [Section 11(e)(2)(A)].
3. The owner of any invention or discovery or of any patent covering such discovery that is taken by the Commission may apply for just compensation [Section 11(d)].
4. Any person making an invention or discovery useful in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon and whose patent rights have been limited or abolished by Subsection (a) may apply for an award [Section 11(e)(2)(C)].

This review of eligible persons reveals that *every* inventor of a device useful in the technology of atomic energy is eligible, according to circumstance, either for an "award," "just compensation," or "reasonable royalties."

Standards for Determining Compensation

There remains to consider the standards that are established for the guidance of the Commission in making its findings. As set forth in Subsection 11(e)(3), these standards are first described for the determination of royalties and are then applied *in toto* to other types of compensation cases, supplemented by consideration of the actual use of the invention or discovery in question. A detailed analysis of the provisions of this subsection follows.

In determining a "reasonable" royalty fee the Commission is instructed to "take into consideration any defense, general or special, that might be pleaded by a defendant in any action for infringement. . . ." This, in effect, restates a general operating principle in patent law often invoked in determining compensation to be paid patent owners whose inventions are used by or for the government without their consent. In other words, when the Patent Compensation Board weighs a claim for royalties on a patent, it may consider such factors as would have constituted a partial or total defense to a claim for royalties and damages in a court of law had the same patent been the subject of an action for infringement.

The Commission is further instructed to take into consideration "the extent to which, if any, such patent was developed through federally financed research." This is an apparently unassailable general principle, but one that must be regarded as something less than firmly established for the whole field of federally financed research. The struggle to determine who shall be the beneficiaries of the discoveries and inventions made possible by the expenditure of government funds during the war has already been joined, though so far it has been concealed from public attention. The Department of Justice wishes the government to retain control of patents on inventions produced by the expenditure of government funds and to use the licensing of devices covered by these patents as a weapon

for combating monopoly.* Opponents of this radical and possibly effective reform proposal have been vigorously, albeit silently, at work both outside and inside the government. Their chances to achieve their purpose, given the temper of the times, seem better than good. In the Atomic Energy Act, however, the principle is explicitly established. Since the release of atomic energy and its technology were, beyond any possible argument, made feasible entirely by the expenditure of public funds, this is by no means a narrow application of the principle.

Thus, it is established that an atomic energy device incorporating scientific discoveries made as a result of the expenditure of public funds or one developed in a federally financed project is not to be regarded as private property requiring the payment of royalties. A manufacturer is entitled to a fair profit for making such a device, but additional compensation in the form of royalties, when there is no risk and, perhaps in some cases, no originality involved, cannot be justified.

The Commission shall consider, also, "the degree of utility, novelty, and importance of the invention or discovery." This is the heart of the valuation problem. Unfortunately, it is also the most complex. An invention, to be patentable, must be "new" and "useful." Yet these are conditions that, borrowing from the apt jargon of mathematical proofs, are necessary but not sufficient. How new? How useful? Inventions incorporating no more than petty improvements or variations proliferate at an amazing rate. The Patent Office is usually swamped with this species, and the Commission may expect the same deluge when the technology of atomic energy has been more fully elaborated.

It should be noted that, in attempting to set a price on "novelty" and "utility," no exact analogy is to be found in a hypothetical

* See United States Department of Justice, Investigation of Government Patent Practices and Policies, Report and Recommendations of the Attorney General to the President, 1947 (United States Government Printing Office). Among the recommendations of this admirable report is the following: "As a basic policy all contracts for research and development work financed with Federal funds should contain a stipulation providing that the government shall be entitled to all rights to inventions produced in the performance of the contract." (Vol. I, Chap. 4, p. 76.)

action for infringement. In an infringement action the damages awarded the patent holder may incorporate a punitive element in addition to the loss of profits sustained by the plaintiff. In determining royalties under the Act, the punitive factor will not be present, except that, where royalties were previously fixed and the licensee under Section 7 failed to pay or where the licensee knowingly infringed on an existing patent, the licensee may be liable for damages and costs in addition. Moreover, the determination of reasonable royalties, on the basis of hypothetical profits that might be derived from the sales (if sales were permitted) of untried devices in an unknown field, presents problems that should tax the powers of a corps of clairvoyants. The Commission must undertake the task aided only by such perception as lawyers, economists, scientists, and businessmen can bring to bear. The onus of demonstrating the novelty and utility of the device must fall on the applicant, and the Commission will probably maintain an attitude of open-minded and judicious skepticism. The task will be most difficult in the early stages and will become easier with the growth of experience and a body of precedents.

The Commission "may consider the cost to the owner of the patent of developing such invention or discovery or acquiring such patent." This factor was deliberately made optional, for in developing any invention the financial investment may vary from a small sum to an amount out of all proportion to the value of the final product. In the realm of ordinary commercial affairs, where the cost of developing a device has been unduly high, royalties can be fixed at a level sufficient to cover costs fully only if the device is of key importance and satisfactory substitutes are not available. Possession of such a device may enable the patent holder to gain a dominating position in the economics of an entire industry. Charged with carrying out the broad social and economic objectives of the Act, the Commission, of course, cannot permit royalties on key devices to be fixed so high that small manufacturers are excluded from the field. In some instances it may be necessary for the Commission to acquire a patent outright in order to accomplish the dual purpose of making the invention it covers widely available and of

compensating the patent holder for costs incurred. When the Commission acquires a patent on a device and makes it available for use by private persons, it may decide to charge a moderate royalty fee sufficient over a period of years to recoup its outlay. The Act does not explicitly authorize this procedure, but it is reasonable to infer that it would be justified.

In addition to these provisions, which by guaranteeing fair compensation seek to encourage private invention, the Commission has authority under Section 3 to finance private research projects under appropriate financial arrangements. In consonance with the general policy objectives of the Act, it appears that the Commission should make inventions developed under this arrangement fully and freely available. If this is indeed the policy followed, it is to be expected that industry will normally prefer to finance its own projects except when these involve large expenditures coupled with tenuous prospects of success. Nevertheless, arrangements made under this authority may be very important in contributing to the work of independent inventors who are hampered in their investigations by inadequate funds.

The same considerations apply to the determination of compensation for the various types of patents wholly or partly revoked under Subsections 11(a), 11(b), and 11(d) and for the granting of awards authorized by Subsection 11(e)(2)(c) to persons not entitled to compensation under the subsections cited. In addition to these considerations the Commission is required to take into account "the actual use of such invention or discovery." The Commission is given the discretion of paying the amount decided either in a lump sum or in the form of periodic payments.

Judicial Review of Compensation

Any inventor or patent owner, dissatisfied with the amount or terms of the award or royalty set by the Commission, may obtain a judicial review of the Commission's determination. The procedure to be followed is similar to that established in other regulatory statutes, such as the Federal Trade Commission Act, the Securities Exchange Act, and the Federal Communications Act. The aggrieved

person files in the Court of Appeals for the District of Columbia a written petition asking that the determination be set aside. The Commission, upon being served with a copy of this petition, files with the court a certified transcript of the entire record. The Commission's findings of fact are conclusive if supported by substantial evidence, and the case is decided upon this record, the court having the authority to affirm the determination of the Commission in its entirety or to remand it to the Commission for further proceedings.

The requirement that the review proceedings be brought in the Court of Appeals for the District of Columbia follows the Federal Communications Act. The facts in these cases will usually be complex and often involve restricted data; limiting review to a single appellate court should serve the double purpose of enabling the court to develop experience in the field of atomic energy and holding to a minimum the number of judges to whom confidential material is entrusted. In reviewing the Commission's determinations the court is governed by the terms of the Administrative Procedure Act, which provides, roughly, that the only ground for setting aside such an administrative determination is that it is arbitrary, capricious, or not supported by substantial evidence.* The court's decision is subject to further review by the United States Supreme Court if certiorari is granted upon petition of the Commission or any party to the court proceeding.

* * *

Upon analysis, this painstakingly fair and even generous series of provisions seems scarcely to merit the extravagant abuse that has been directed against it. The section takes scrupulous care that no rights are infringed without just compensation and that no future discoveries or inventions in the field of atomic energy shall fail of adequate award. What it does, of course, is to intrude rudely into certain sanctuaries of the patent system regarded as sacred, not by scientists and inventors, but by practitioners of the art of economic manipulation. The conclusion is difficult to escape that these were

* See Chap. 13, p. 279*ff*.

the persons offended and that the aspect of the patent provision that outraged them most was not its failure to make adequate financial compensation for any property rights it impaired, but the simple and efficient way in which it eliminated from a whole vast area of enormous, potential, economic significance all possibility of manipulating patents as an instrument for achieving privileged position and monopoly control.

9. Research

In nature's infinite book of secrecy
A little I can read.

William Shakespeare,
Antony and Cleopatra, I

What men of science want is only a fair day's wages for more than a fair day's work.

T. H. Huxley, *Administrative Nihilism,* 1871

There is no possibility of telling whether the issue of scientists' work will prove them to be fiends, or dreamers, or angels.

Lord Rayleigh, Address to the British Association, Cambridge, 1939

Science has promised us truth—an understanding of such relationships as our minds can grasp; it has never promised us either peace or happiness.

Gustave Lebon, *Psychologie des foules,* introduction, 1895

The Social Function of Science

The Hiroshima bomb shattered whatever remained of the religion of science. This brave faith had sprung up in the eighteenth century in the midst of the incipient disintegration of established religion, had flourished and won converts during the nineteenth century, only to begin to disintegrate itself in the twentieth, victim of its own self-generated doubts. At best, it had been a frail and bloodless substitute for the ancestral certainties it attempted to supplant, and the members of its cult were never great in numbers or in zeal.

Modern science has encompassed its own disintegration as a religious faith. The tidy mechanistic universe, the ordered system of natural laws expounded by Galileo, Kepler, Newton, and Laplace, has been hopelessly shattered and undermined by the theories of Planck, Einstein, Bohr, Heisenberg, and Schrödinger, to mention only the most outstanding of the heretics.

But the core of the disillusionment among laymen has been the growing realization that, for all the extraordinary progress in invention and discovery and the enormous advances in the mechanical arts, science has solved none of the fundamental problems of man—neither peace, nor wealth, nor happiness; least of all has it brought security.

This realization has been growing for some time. If final proof were needed, it was vouchsafed in full measure at Hiroshima. Even the staunchest defenders of the faith would no longer argue that science is necessarily a beneficent agency, operating independently of men's wills and purposes; salvation, it is painfully clear, does not lie that way. In the method of science man has found an instrument of unexampled power. Its effective use offers him the only promise of escape from the drudgery, superstitions, and ills that beset him. But it is no more than an instrument and its powers for ill are at least as great as its powers for good.

The point is eloquently made by Lewis Mumford: * "No matter how completely technics relies upon the objective procedures of the sciences, it does not form an independent system, like the universe; it exists as an element in human culture and it promises well or ill as the social groups that exploit it promise well or ill. The machine itself makes no demands and holds out no promises; it is the human spirit that makes demands and keeps promises."

Never has the ambivalence of science been so clearly demonstrated as in the case of atomic energy. "The significance of the atomic bomb for military purposes is evident," wrote the draftsmen of the Act with classic understatement. But atomic energy has another significance as well. Constructively developed, it may be a source of health and wealth for the whole of society. These ends will not realize themselves, however; progress in research and in the useful applications of atomic energy cannot be expected to occur automatically. The Act explicitly recognizes this fact and by implication acknowledges some of the difficulties and handicaps that beset all scientific development. It seeks to assure the rapid and beneficent exploitation of atomic energy for constructive purposes by provid-

* *Technics and Civilization* (Harcourt Brace, New York, 1934), p. 6.

ing for a research program that may cut through most of the obstructions that normally retard scientific progress.

There is probably something less than universal understanding of what these difficulties are. As devotedly as we in the United States have subscribed to the cult of science and as richly as we have benefited from science's practical achievements, we have given little consideration to such matters. In point of fact, there is in this country virtually no theory of the social function of science. We practice science with a zealous ardor and amid an ingratiating folklore carefully nurtured in the institutional advertising of the firms that dominate the fields of electronics, metallurgy, and synthetic chemistry. But there is a remarkable poverty of literature that deals critically and analytically with the organization of scientific research—its strengths and weaknesses, the interests that control it, the purposes it serves, the problems that beset it, the accomplishments of which it might ultimately be capable. Cogent and incisive analyses of these problems have been published in England by writers such as Julian Huxley, J. D. Bernal, Douglas Hill, and J. G. Crowther, but we can find no comparable studies in the United States.

Aside from the materials prepared for the Senate Subcommittee on War Mobilization and Dr. Vannevar Bush's report to President Roosevelt, entitled *Science, the Endless Frontier,* there has been very little recent recognition that such problems exist.* The investigations of this Subcommittee and the several bills designed to provide some permanent means of mobilizing our scientific resources, which were introduced in the Seventy-ninth Congress, grew out of experience during the war—the difficulty we had in organizing scientific research and its enormous productivity when organized.†

* One report, however, which appeared almost a decade ago, must be regarded as a landmark in the development of national science policy. Some of its recommendations have been adopted, but the majority of the problems raised are still unanswered. See *Research—A National Resource,* issued by the National Resources Board in 1938.

† See footnote on p. 16 for reference to the Smith bill introduced and passed in the Eightieth Congress and vetoed by the President. This was a badly twisted variant of Senator Kilgore's original measure for the establishment of a National Science Foundation.

The Kilgore bill, introduced by the Chairman of the Subcommittee, was the most comprehensive of these measures. It provided for a National Science Foundation authorized to study the problem of coordinating all government-financed research activities and to promote any research that is in the national interest, including basic sciences and natural resources as well as health and medical science. If this bill, which was passed by the Senate, had been enacted, it would have provided a framework for the research activities of the Commission and would, incidentally, have greatly simplified the task of exposition here. As it is, the general task of the Commission in promoting research on atomic energy is undefined by institutions and uninformed by literature.

Scientific Research in the United States

There is little real understanding among the American public of the true nature of scientific work and scientific progress. There is small conception of the organic nature of science, its complex interrelations and unpredictable cross-fertilizations; little idea of the toil, devotion, patience, and cooperation required of scientists, of the enormous numbers of unrecorded disappointments and failures that precede almost every success. There is no appreciation of the fact that the epoch-making developments in science have more often than not been achieved by the use of equipment no more intricate and expensive than pencil and paper and that when first made these discoveries had no apparent practical value. There is no realization that science is an essential human activity, depending on communal effort and support, and that it is as much shaped by social and economic circumstances as it, in turn, is a force for social and economic change.

The popular attitude toward science in the United States is a mixture compounded of superstition, awe, and vulgar delight in the gadgets it is assumed to proliferate. In this general mentality a quaint folklore has taken root and flourished, aided in no small degree by the publicity policies of some of our larger firms. Science wears a white coat and is dedicated to the service of humanity; it

has enriched and lengthened life; it has a motive power of its own that is perpetual—once started somewhere in history, it will go on forever without halt, a sort of chambered nautilus, eternally finding within itself the power to build more stately mansions for the human race.

This idea is closely related to the conception that scientific genius is solitary and requires no nurture. In the public mind are images of the Wright brothers at work in their bicycle shop contriving the first flying machine and of Edison plumbing the mysteries of electricity with a few magnets and some pieces of wire. The ability of these images to exist comfortably side by side with the reality of the gigantic research laboratories of such firms as Westinghouse, General Electric, and Du Pont would be incredible were it not for the fact that the public imagination has so convincingly and so often demonstrated its flexibility in the past. As Thurman Arnold has incisively pointed out, it has never experienced any difficulty in retaining its pristine picture of a free economy composed of small businessmen despite all the facts of corporate concentration.

The folklore of science in the United States is, in fact, part and parcel of the general folklore of capitalism. As in our economic system, a basic structure of laissez-faire individualism has undergone profound modification as a result of corporate concentration, privilege, and experience, while loyalty and homage continue to be offered to the ancient stereotypes. The "little businessman" has his counterpart in the "little inventor." All this, of course, is to say that science in our society has been a part altogether consistent with the whole that comprises it.

Who Guides United States Research?

Before the war, the total expenditure on scientific research from all sources in the United States was between 300 million and 400 million dollars per year, of which about one sixth was provided by the government and one sixth by universities and research foundations. By supplying two thirds of the total funds expended, private industry was able to dominate the field, determining the emphasis and direction of research.

The participation of the Federal government in scientific research had gradually increased over many years until by 1938 it accounted for approximately one fifth of the total sum spent in financing such activity.* It sponsored, or itself conducted, research in a number of fields—agriculture, the physical sciences, public health, and meteorology being among the most important. By 1939 there were no less than forty scientific agencies established within the Federal government.

The war, of course, profoundly altered the nature, dimensions, and structure of scientific research in the United States. From 1938 to 1944, federal research expenditures increased more than tenfold, from 68 million to 706 million dollars per year, while expenditures on private research diminished from nearly 200 million to less than 100 million dollars. The results of this investment of federal funds for research were impressively recorded in battles fought over the entire world.

Apart from its dominance during the war and postwar period, the participation of the Federal government has been limited and at no time has it formulated an over-all policy designed to further scientific research in the public interest. Describing the role of the Federal government in research, Dr. Vannevar Bush writes in his *Science, the Endless Frontier:* †

Much of the scientific research done by government agencies is intermediate in character between the two types of work commonly referred to as basic and applied research. Almost all government scientific work has ultimately practical objectives. But in many fields of broad national concern, it commonly involves long-term investigations of a fundamental nature. Generally speaking, the scientific agencies of government are not so concerned with the immediate practical objectives as are the laboratories of industry, nor, on the other hand, are they as free to explore any natural phenomena without regard to possible economic applications as are the educational and private research institutions. . . . We have

* This and other data following are to be found in Legislative Proposals for the Promotion of Science; Subcommittee on War Mobilization of the Committee on Military Affairs, United States Senate, Pursuant to S. Res. 107 (Seventy-eighth Congress) and S. Res. 146 (Seventy-ninth Congress) Authorizing a Study of War Mobilization Problems, August 1945, Seventy-ninth Congress, First Session, Senate, Subcommittee Print.

† United States Government Printing Office (July, 1945).

no national policy for science. The government has only begun to utilize science in the nation's welfare. There is no body within the government charged with formulating or executing a National Science Policy. There are no standing committees of the Congress to vote on this important subject. . . . There are areas of science in which the public interest is acute which are likely to be cultivated inadequately if left without more support than will come from private sources . . . we are entering a period when science needs and deserves increased support from the public funds.

Congress was so impressed with the results of its wartime investment in research that it considered measures that would correct these deficiencies and guarantee to the nation that its scientific skills would continue to be effectively utilized both in providing for the common defense and promoting the general welfare. President Truman, in his message of September 6, 1945, strongly urged upon Congress the enactment of legislation that would permit the utilization of the resources of the Federal government in furthering scientific research, and the Senate passed the Kilgore bill, which would have realized this object through the establishment of a National Science Foundation charged with the task of promoting scientific research in the national interest. The bill died in the House, however, quietly smothered in committee.

Distortion of Emphasis

Of the amounts expended by industry for research, only an infinitesimal fraction was spent on anything other than projects that were expected to show a prompt and satisfactory profit for the firm conducting them. This emphasis on prompt private profits as a precondition to scientific research has resulted in inadequate attention to basic research [discussed in (c) below] and in concentration on applications of less value to the public.

These deficiencies are no doubt due in part to our inherent pragmatism, coupled with a degree of short-sightedness that is unable to perceive the ultimate practical value of work that may be long in fruition. As a people, we insist on prompt results, and the theoretical and speculative have always seemed antipathetic to our

character. These are probably the underlying and determining factors, but sufficient cause can be found in the methods of financing scientific research already described. As befits a characteristic element in our society, scientific research must hold forth the prospect of quick cash dividends on the investment, in which event it is financed by industry, or else it exists on alms alone.

To be sure, some of our largest corporations have come to recognize the seminal nature of discoveries growing out of basic research and to make provision for such activity, but the amount of financial support that basic research receives from this source is decidedly limited. Though a particular discovery in basic research may result ultimately in the creation of millions of dollars of wealth, it is difficult to restrict potential profits to a particular firm, and from the point of view of possible economic returns, such projects must be regarded as excessively long-term and highly speculative.

The distortion of emphasis has had one further unfortunate effect. No branch of science is a separate, independent entity, and neglect of any one branch retards the development of all science. Repeatedly, an advance in one scientific discipline has affected another branch apparently wholly unrelated. As science grows increasingly complex its structure comes to resemble a gigantic telephone exchange; behind the orderly array of switchboards and panels is an intricate network of circuits and intertwining strands of communicating wire, each strand distinct and separate in function, yet related to all the others. One of the principal means of advancing science is finding the strands that link physics and chemistry, chemistry and biology, biology and the social sciences, the social sciences and psychology.

Federal research has not supplied a well-balanced emphasis. The enormous wartime expansion of federally financed research was, of course, for military purposes. "In the five fiscal years of the defense-war period, nearly two billion dollars was spent on government research. This included three-quarters of a billion by the War Department, and roughly one-third of a billion each by the Navy and OSRD." * In the fiscal year 1947 the sum spent for research and

* Report No. 5, Senate Military Affairs Subcommittee on War Mobilization, Seventy-ninth Congress, July 23, 1945.

development by the government reached the fabulous peacetime figure of $613,000,000, of which the War and Navy Departments controlled approximately 85 per cent.

In contrast to the lavish expenditure for defense, consider the sums available for research in medicine—also a matter of fundamental concern to the nation. Our fatal casualties during the war were about 300,000. Our research investment on military weapons amounted to approximately $600 for each life lost. Every year deaths from heart disease amount to about 500,000—a number substantially in excess of our war fatalities. Yet the annual research budget for heart diseases has been at the rate of $0.17 per death. Kidney diseases killed more than 100,000 people in 1940; research expenditures in this field amounted to about $0.38 per death. By these standards, the $2.15 per death devoted to cancer research annually seems generous in the extreme.

Research expenditures on agriculture have been lavish when compared with the budget of medical research, and yet, judged by the standards of the wealth such research has contributed to the community, the amount involved is negligible. With the sum spent in one year on advertising the infinitesimal differences that distinguish certain brands of cigarettes from certain other essentially similar brands, agricultural research would undoubtedly add tens of millions of dollars to the national wealth. The 17-billion-dollar military budget for fiscal 1947—for one year—greatly exceeds the expenditure on *all research* in *all fields* since the founding of the United States.

In the main, it is clear that research, whether basic or applied, has suffered wherever it has not promised immediate financial returns to private enterprise or direct military returns to the Federal government. And this means that as a consequence all science has suffered.

Weakness in Basic Research

We have already noted the poverty of the literature in the United States that attempts to probe the basic problems of the role of science in a democratic state. This failure to get to the theoretical bases of

action is carried over into the whole field of scientific research in this country. Our analysis of research activities in the United States will reveal a number of serious shortcomings, most of which relate to the factors discussed in the preceding section. But the ultimate and, unless corrected, the fatal weakness is our deficiency in basic research.

Almost all basic research before the war was conducted by universities and research foundations. But the amount spent by such institutions on research activities amounted to only about one sixth of the total funds spent. Nevertheless, for practical purposes these institutions may be regarded as the sole American source of discoveries in basic research. This source was supplemented by the basic research done in Germany with the support of the German government, upon which we relied heavily.*

The comparative poverty of basic research in the United States is made painfully clear by testimony of distinguished scientists before the Senate Subcommittee on War Mobilization. The following trenchant observations are taken from the testimony of Dr. Harlow Shapley:

> It should be somewhat humiliating to us to realize that the revolutionary sulfa drugs had their beginning in German research laboratories; that atom-splitting was discovered in Berlin; that the basic pioneer work that has led to radio and radar and the enormous American electronic industries was that of a German professor. Penicillin came from England; DDT from Germany and Switzerland. . . . Hereafter we must rely on ourselves for basic research.†

Dr. Harold C. Urey in his testimony gave statistics showing the number of Nobel prize winners in the United States and in Europe. Since the inception of the award in chemistry, where Dr. Urey himself was a distinguished winner for his discovery of heavy water, 36 prizes have gone to Europeans, of whom 17 were Germans, as

* Our indebtedness to German science extended to applied research as well. Although the extent of our borrowing from this source has never been accurately assessed, through the international cartel system it was undoubtedly considerable.

† "Hearings on Science Legislation," War Mobilization Subcommittee of Senate Military Affairs Committee, Seventy-ninth Congress, Part I (Oct. 9, 1945), p. 49.

compared with 4 to Americans. In physics 39 prizes have been given, of which 11 went to Germans, and 8 to Americans. In medicine and physiology 36 prizes have been given, of which 9 went to Germans and 6 to Americans. Dr. Urey observed:

> The relatively small number of Nobel Prizes awarded to United States citizens indicates the weakness of this country in pure science and also, by contrast, its great strength in industrial development. We have improved our scientific position during the past 25 years, but through all our history we have drawn on Europe for fundamental science. Our technical and industrial developments are the offspring of this important fundamental science . . . The great advance in technology comes only as a result of work in pure science in which the primary objective is an understanding of the fundamental laws of natural phenomena. At no time from the discovery of radioactivity in 1896 until about 1938, could anyone have asked specifically for the development of atomic energy into atomic bombs or power plants. Through all these years it was only the desire of scientists to understand natural phenomena which finally brought us to the stage where such development could go forward . . . If I were speaking in Europe, I would advise a committee such as this to put first emphasis on industrial application. Speaking before this committee of our own Congress, I wish to advise that first emphasis be given to fundamental science.*

The Economics of the Practice of Science

For all the esteem in which science—at least in its practical applications—is held in the United States, its pursuit is an economically precarious undertaking. This statement may appear to be exaggerated. Is not science the leading discipline of many universities, and do these institutions not possess great laboratories? Are there not research foundations that spend millions on research each year? Is not industrial expenditure on research in the United States higher than anywhere else in the world and steadily rising? Isn't the Federal government spending hundreds of millions of dollars this year on research and development?

These questions must all be answered in the affirmative. Unfortunately, however, this series of affirmations does not add up to the

* *Ibid.*, Part III (Oct. 25, 1945), pp. 658-659.

general proposition that our scientific research is adequately and wisely financed in all of its aspects.

A more careful examination of the practice of science in this country reveals that—aside from the fatal neglect of basic research and the distortion by special interests already considered—scientists in academic institutions are poorly paid and research workers as a class are miserably compensated.

The difficulties in the path of the young scientist in this country who wishes to follow a course of independent research are numerous and acute. He must wangle a university appointment or a research grant, neither of which achievements is necessarily intimately related to his scientific accomplishments. The number of aspiring scientists is large, while academic appointments and research grants are limited. The consequence is that after a year or two of effort many young scientists gladly exchange their prospects for achievement in the realm of pure science for the security offered by a post in industry or, lately, with lavish amounts available to the services, in government. Bernal,* in writing of the situation in England, observes that it is taken for granted that the young research worker must seek a place in industry. "On one tour of inspection," he reports, "some government officials were as shocked at a young research worker actually stating that he expected to continue in research as were the workhouse authorities when Oliver Twist asked for more." The situation is not without parallel in the United States.

In short, while it is true that a large number of scientists are motivated by noneconomic considerations, in the end, if they are to practice their profession, they are forced to seek employment where research money is available. As we have seen, until the advent of the war this often meant working directly or indirectly for industry.

Availability of Scientific Personnel

The war occasioned a serious interruption in scientific training both in educational institutions and in basic research laboratories. Young scientists and scientific students were drained off into the

* J. D. Bernal, *The Social Function of Science* (Macmillan, New York, 1939), p. 82.

armed forces or into applied research for industry or the government as a part of the war effort. The gap in the ranks of scientists resulting from the war recruitment policies of the government will not be closed for years to come.

Large research expenditures by the Federal government, in the absence of a coordinated program, have accentuated the shortage by depleting scientific faculties in the universities. The existence of this problem has been recognized by the President in Executive Order 9791, which directed that a study be made of the government's research program in relation to available scientific personnel and the training of new scientists.* Until a balanced program is established, however, it is clear that scientific education will be seriously handicapped since never before has so much money been available for direct research, never before has there been so feverish a competition for skilled personnel—a competition in which universities must inevitably come off second best so long as they are forced to apply the niggardly salary scales that are standard in American educational practice.†

In scientific research, as in all other fields, the nation seems to be obsessed with the desire to return to an illusory "normalcy." In this context the research provisions of the Act appear all the more remarkable and no doubt the task of the Commission in giving them practical effect seems all the more difficult. For the research provisions of the Atomic Energy Act in several major respects take the Federal government a considerable distance further into the field of scientific research than it has ever gone before.

* For a full discussion of this and other points related to Federal Research policy see the summary contained in *Science and Public Policy,* Vol. 1, *A Program for the Nation,* a report to the President by John R. Steelman, Chairman, The President's Scientific Research Board, August 27, 1947, United States Government Printing Office, Washington, D. C. The other volumes of the report are: (2) *The Federal Research Program;* (3) *Administration for Research;* (4) *Manpower for Research;* (5) *The Nation's Medical Research.* Altogether this is an exhaustive and valuable study, an appropriate companion piece to the Attorney General's Report on Patent Practices of the Federal Government referred to in the footnote on p. 165.

† In the last year or two many of the larger universities have gained profitable contracts for army or navy sponsored research on a scale unheard of in the modest academic lexicon. But these financial gains are more than offset by serious disadvantages, including a further skewing of institutional research toward military ends with a corresponding neglect of both basic research and teaching, especially as regards graduate students.

Provisions of the Act

Section 3 of the Act not only authorizes but *directs* the Commission "to exercise its powers in such manner as to insure the continued conduct of research and development activities . . . by private or public institutions or persons and to assist in the acquisition of an ever-expanding fund of theoretical and practical knowledge. . . ."

The report of the Senate Special Committee on Atomic Energy summarizes the broad intent of Congress in framing this provision:

> The Committee recognizes that only by continued progress in science can the purpose of the bill be achieved. It is firm in its opinion that continued progress will depend, in the future as in the past, on the free and disinterested work of the thousands of scientists and research workers in private laboratories and universities throughout our country and the world. Science is not made by its titans alone.

The Commission is assigned two major research responsibilities—assisting research activities in private and public institutions and conducting independent research. Before considering these activities, let us first determine the scope of research as defined by the Act.

Definition of Atomic Energy Research

The subject matter of atomic energy research as stated in the Act is potentially of enormous extent. The fields in which the Commission is assigned primary responsibility are:

(1) nuclear processes;

(2) the theory and production of atomic energy, including processes, materials, and devices related to such production;

(3) utilization of fissionable and radioactive materials for medical, biological, health or military purposes;

(4) utilization of fissionable and radioactive materials and processes entailed in the production of such materials for all other purposes, including industrial uses; and

(5) the protection of health during research and production activities [Section 3(a)].

This language would appear broad enough to include a substantial part of physics, much of chemistry, segments of biology, geology, physiology, and mathematics, to list a few. To the extent radioactive tracers are used to study natural processes, all of the physical and biological sciences are included. The definition of research and development is framed no less comprehensively. Section 18(e) provides:

> The term "research and development" means theoretical analysis, exploration, and experimentation, and the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes.*

Research Work Performed by the Commission

It is apparent from the above quotation from the Senate Committee Report and from the terms of Section 3 of the Act that Congress intended the major burden of research to be borne by private individuals and nongovernmental institutions, with the Commission itself performing only supplementary functions in most fields.

We have already seen that in the past government ventures in research have tended to fall midway between basic research and the development of commercial applications. With certain exceptions, the research work of the Commission will probably take this same middle road. As will appear in the discussion below, the principle seems sound that basic research should be, so far as possible, left to the universities and the foundations. Research that promises to eventuate in profitable commercial discoveries, on the other hand, can for the most part be safely entrusted to private enterprise, though it may be that in some cases the zeal of private firms for research will be tempered somewhat by the compulsory licensing provisions of Section 11.

However, under the best possible circumstances there will be gaps in both types of research activity, and moreover, there is an undefined but important middle ground between the two, comprising

* Senate Report No. 1211, Seventy-ninth Congress, Second Session, p. 13.

those researches that are not basic in character but are either of such general significance or of such long-term or speculative character that they cannot be justified on a commercial basis. Under the terms of the Act it is clearly the duty of the Commission to fill these lacunae.

Finally, in those processes that the Commission monopolizes—namely, the production of fissionable material and military weapons utilizing fissionable material or atomic energy—the logic of circumstances probably dictates that the government undertake most of the research itself; the Commission alone in the case of research relating to production techniques and the Commission in cooperation with the War and Navy Departments in the field of military weapons. These processes are government-monopolized and most information relating to them will no doubt remain classified. So long as secrecy is a major consideration, the concentration of research in these fields (exclusive of basic research) in government laboratories seems a logical procedure.*

The Act clearly contemplates that research in the Commission's laboratories will be carried on directly by the Commission rather than under contract with private firms or universities as was the practice of the Manhattan District. The Commission is *directed* "to conduct, through its own facilities" research activities [Section 3(b)]. The Senate report reinforces this direction by stipulating that "The Commission is also directed to carry on, supplementary to these aids to private and public institutions, its own program of research . . . through its facilities and under its supervision." †
This requirement does not seem to be met by continuing the operation of Commission research facilities by independent contractors rather than by the Commission itself. Indeed, the direct operation of

* That is to say, either in government-owned and -operated laboratories or under contract with private groups, the projects to be federally financed and supervised and to utilize, where necessary, government-owned apparatus. The practice now followed by the Commission of conducting research exclusively by contract or through the medium of independent contractors utilizing government-owned facilities (*e.g.*, Associated Universities, Brookhaven, New York; University of Chicago Group, Argonne Laboratories, Chicago, Illinois, etc.) instead of establishing its own research facilities manned by federal employees, seems to us an improper evasion of responsibilities clearly fixed in the Act. Nor is the practice even justified on its merits.

† *Op. cit.* p. 13.

these facilities is probably the principal function of the Division of Research, since that division is expressly enjoined from handling research contracts (page 36).

Research by Other Government Agencies

By no means should all government research in the field of atomic energy be conducted by the Commission. One of the basic principles of the Act is that research must be free of all restraints except the minimum required by security and considerations of public health and safety. This freedom extends not only to private individuals but to other agencies of the Federal government. Over such agencies the Commission is given by the Act only such powers as derive from its general regulation-making and inspection authority.

In Chapter 11 we analyze in some detail the probable distribution of research functions between the Commission on one hand and the service departments on the other. We reach the conclusion there that in practice the division of functions will depend more on appropriations and available personnel than on any general principle of administrative organization. This same conclusion is no doubt applicable to the allocation of research functions between the Commission and all other government agencies.

In principle it would seem desirable to concentrate functions relating to atomic energy research in the Commission as far as practicable. This generalization, however, will not be particularly useful in determining the question of whether in fact it would not be more efficient for the Public Health Service to conduct a particular research project involving the use of radioactive isotopes in the treatment of cancer or for the Department of Agriculture to work on the effects of radioactive emanations on plant growth; in any case it will certainly not be determinant.

At the least it can be asserted that the Commission must be thoroughly informed as to the atomic energy work of all government agencies and must assume the initiative in making sure that the various programs are effectively coordinated. If, as appears likely, an executive order is required to achieve this, the Commission should endeavor to secure its issuance. In the case of the War and Navy

Departments, the Military Liaison Committee should make the task of coordination relatively simple. So far as other government departments are concerned, it will probably be necessary to create an interdepartmental research committee to discuss common problems and work out joint programs.

The Commission's Research Personnel

One of the conditioning factors that will determine both the scope of the research work undertaken by the Commission itself and the general effectiveness of its whole program under Section 3 is the caliber of staff it succeeds in recruiting and holding. This problem, of course, is not peculiar to the Research Division of the Commission, but it is here that it is likely to be acute.

The problem of recruiting a staff of first-rate scientists has never been an easy one for the simple reason that highly qualified scientists in this or any other country have always been a scarcity item. The situation is now more acute than ever before for the reasons indicated earlier. Thus, in an area of limited man-power resources the Federal government must compete with academic institutions and industry to an unfortunate degree. The failure of Congress to establish a central federal research agency, the enormous drain on scientific resources imposed by swollen military research programs, and the lack of a coordinated federal research policy all set further obstacles before the Commission in the matter of personnel.

Personnel may be employed and their compensation fixed without regard to civil service laws [Section 12(a) (4)].* While this permits of salaries that should enable the Commission to attract younger scientists and, generally, those commanding salaries in the middle range ($5,000 to $10,000), the Commission will be unable to match the pay offered by industry to men of outstanding ability and reputation. On the other hand, the Commission offers the advantage of great laboratories and of access to the full range of existing data. If, in addition, it adopts a liberal and imaginative policy in giving men of proven scientific ability the opportunity to pursue research in fundamental science without compelling them to justify their

* But see footnote on p. 277 concerning action of the Appropriation Committee.

positions by practical inventions or discoveries, there will be much to persuade the services of any scientist, however attractive his current position. Furthermore, there will always be scientists, among them those of outstanding competence, who will be drawn to the public service because of its unique opportunity for practicing science directly in the service of man.

It would be unwise to overlook the fact that neither the achievements of governmental research agencies nor the opportunities they offer have hitherto enjoyed the highest reputation. Many scientists are of the opinion that the research worker under civil administration is denied the freedom that can be found in academic life or in the pursuit of science in some of the larger industrial laboratories. On such matters as hours, vacation time, and general routine of work, it is undeniably true that university research offers a more acceptable atmosphere to the scientist than does the average government laboratory. But the Commission has discretion in these matters, and an intelligent, imaginative administrative policy will make considerable difference in the conditions that the scientists of the Atomic Energy Commission will face. There are, moreover, advantages in government employment—economic security most notably—that, to many scientists, would counteract some of its drawbacks and thus outweigh other advantages offered by industry or academic institutions.

Arrangements for Support of Private Research

The Commission is not merely "authorized," but "*directed*" to give financial support to independent research. The purpose of the direction is evidently to offset any undue conservatism on the part of the Commission and perhaps to facilitate obtaining from future Congresses adequate appropriations for this phase of the Commission's functions.

In describing the kinds of financial support that the Commission shall furnish, the Act uses the word "arrangements," enumerating by way of illustration, "including contracts, agreements and loans." The term "arrangement" is sufficiently flexible to cover all types of financial aid, including contracts for entire projects or, separately,

funds for salaries, equipment, materials, and buildings needed in connection with research. As originally adopted by the Senate, the McMahon-Douglas bill included "grants-in-aid" under possible "arrangements." Unfortunately, for reasons difficult to fathom, the House of Representatives, while leaving intact the balance of the research section, voted to eliminate this form of support. When the point arose for brief discussion during the House-Senate conference, the view was expressed by the Senate conferees that the term "arrangements" was sufficiently broad to cover "grants-in-aid" by implication, whereupon the Senate receded. Had "grants-in-aid" not appeared in the version of the bill first passed by the Senate, this construction would certainly be accepted; however, now that the legislative history shows that the term once appeared but was subsequently stricken, it may be argued that the Commission is precluded from giving financial grants to individual research workers—an especially desirable arrangement in the case of young scientists conducting independent investigations. Thus, the Commission may have no alternative but to finance "projects" instead of supporting individuals, including in the project contracts, where it seems desirable, the stipulation that part of the funds are to be made available to research workers engaged on the project. In any event, the Commission should keep in mind the demonstrated fact that highly original work is often done by young men, comparatively unknown, holding no teaching position and therefore wholly dependent upon grants for pursuing their research, and should make every effort to perfect arrangements whereby the talents of such scientists can be fully utilized.

Where contracts for projects are made with institutions, scientists engaged on the project usually will be responsible to the institution rather than to the Federal government. It is by no means desirable, however, that this become an inflexible rule. In some instances it may prove advantageous to make arrangements directly with individual research workers even though they may be using laboratory facilities belonging to an academic institution. The Commission, in every case, should be free to make arrangements that will best serve

the particular inquiry or study and at the same time promote the general objectives of the Act.

In all probability, the Commission will favor contracts for specific projects over general grants. Such a policy will give assurance that the work done will be consistent with the Commission's over-all program and, furthermore, will enable the Commission to single out for support in each institution the type of research that the institution is best qualified to perform.

The Commission is permitted to make arrangements for supporting research without regard to the customary provisions requiring advertising and competitive bidding "upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable, and may make partial and advance payments under such arrangements, and may make available for use in connection therewith such of its equipment and facilities as it may deem desirable." Neither advertising nor competitive bidding is properly applicable to contracts or other arrangements for scientific research and the Commission would have been given an unqualified exemption had the Comptroller General not insisted upon the present provision. Where the subject matter of the contract is research, however, there should be little difficulty in certifying that "advertising is not reasonably practicable."

Authority to make partial and advance payments is also necessary to proper placement of research contracts. This flexibility is essential in those cases where the contractor is unable to perform unless he receives an advance of funds as where the contract involves very large expenditures for equipment and materials or where the span of the contract is of considerable duration. Most research contracts will fall into one or both of these categories. Universities or academic institutions awaiting payment on completion will not usually have sufficient funds to see a contract through. Small institutions particularly would be unable to acquire the expensive apparatus and materials or to hire the additional staff needed to conduct a research project in nuclear physics. Research projects in the field of atomic energy are also likely to be of considerable duration so that

the contractor will need funds as the work progresses. Instances of misuse of the power to make partial and advance payment were by no means rare during the frenzied and confused days of war contracting, as Congressional investigations have revealed. But these abuses are not the inevitable concomitant of this authority and, with the urgency of war removed, the Commission should succeed in avoiding the blunders of the past.

Authority is given the Commission to make available for use in connection with research contracts "such of its equipment and facilities as it may deem desirable" [Section 3(a)]. This provision, also based on wartime precedents, will enable the Commission to obtain research assistance from institutions and individuals who, while scientifically qualified to perform useful scientific work, may for various reasons be unable to acquire the requisite facilities and equipment. The provision, furthermore, makes it possible to reduce substantially government expenditures for research. The same equipment can be lent for different projects to separate institutions, thus making it unnecessary for the Commission to finance the purchase of new apparatus for each project. In this way, also, many small academic institutions and small industries, otherwise barred, will be given the wherewithal to participate in the atomic energy research program.

Requirements of a Sound Research Program

Planning and Freedom of Science

The establishment of a satisfactory system of financing must fall far short of its objective unless it is part of a comprehensive policy for placing science in the most effective position in our social, economic, and political system. Research, in other words, needs more than sound financing. Scientific activities must be planned and coordinated to assure their continuing vigorous contribution to human welfare. But while science is popular, a government policy that entails "organization," "planning," and "coordination," especially when it touches on private activities, is not. In the minds of many

these concepts are linked with various odious political philosophies judged to be altogether inconsistent with the American way of life. "Planning," they hold, violates the "freedom" of science.

There is no occasion here to do more than refer to the curious distortion that the concept of freedom has undergone in the United States. The utter illogic of identifying freedom with a complete absence of political controls over economy has been sufficiently commented upon during the past decade, as has the curious fact that the most vocal opponents of efforts of the state to bring some degree of order and social justice into the operation of the economic system were the individuals most actively engaged in reducing larger and larger areas of the economy to organization and control through the device of the corporation and the holding company.

It is perhaps not so generally realized that an almost identical situation exists in the field of science. Here the fraud has been more decently concealed, both because the aura of sanctity and mystery that surrounds science has been more difficult to penetrate and because there has been little to stimulate the prying of the irreverent. In the concept of freedom of science we see the joining of the profit motive with an almost religious veneration for truth—an abstraction that in this field it is assumed can be served only by the efforts of the individual scientist, unregimented, unregulated, uncoordinated, and, presumably, unsubsidized. In this connection we refer to the image already described in our discussion of the folklore of science—the free scientist serving truth, equipped with a vision and the paraphernalia of a home-grown workshop.

There are those, of course, among the inveterate opponents of planning, the rabid proponents of "freedom of science," who would flatly deny that scientific research can be planned at all or would at least insist that science is most effective when left to follow its own bent with each scientist avidly pursuing truth as he sees it. The concept of the free market is a ubiquitous one and it should not be an occasion for surprise to encounter it once again. The fact of the matter is, of course, that this principle, whatever validity one is willing to ascribe to it as a self-regulating device in economics, is hardly applicable to scientific research—at any rate, to research in the

twentieth century. Left to the forces of the market place, the research that gets done is for the most part that which promises prompt and satisfactory financial return, and in the operation of this selective process, truth, in the sense of new insights into natural phenomena and processes, is frequently lost altogether. Unsupported, science can summon only a small portion of its full vigor; unorganized, science as a whole remains radically disorganized: in either event, it exerts no more than a fraction of its power in the service of man.

The truth is that not only *can* research be planned but, as a matter of fact, it always *is* planned. The individual worker plans his program: if his work is part of a larger project, it is obviously fitted into the main scheme; if many projects can be coordinated so as to mount a joint attack on a common problem, great results can be achieved, as we have seen in the case of the atomic bomb.

Let us analyze briefly the nature of the scientific freedom that it may be feared the Commission will impair. The really free scientist—in the sense of the individual who frames his own research program with no other consideration than the service of knowledge and carries out this program without hindrance or diversion—does not exist except occasionally as an isolated phenomenon. Scientists as a class do not live on unearned income; they are dependent on what they can make. This being the case, they must work for universities, foundations, or industry. If they work for universities, they will enjoy a relatively wide latitude of choice in their activities, but this latitude is being progressively narrowed by the practice of universities in undertaking research projects for industry or for the armed services, which commit the services of their staffs. Those unaffected by this practice will, in any event, live not far from penury and will feel a certain pressure to pursue activities that show quick results in publication, for of such stuff are promotions made. If they apply for a foundation grant, their chance of success will depend, in the first place, on whether their project falls within the general plan of the foundation directors, and their recognition of this fact will in some degree narrow their freedom of choice. The usual grant is for short duration, and during a considerable portion of its closing months the thoughts of the beneficiary will of necessity be oc-

cupied with the problem of acquiring a means of livelihood. The portals of industry, always wide open to scientists of ability, offer a permanent escape from the nagging problems of economic insecurity and also put a permanent end to the academic question of whether the scientist is really free. This metaphysical problem need never trouble him again; he knows positively that he is paid to order his activities, which in turn are based on a frank assessment of profits, in accord with the plans of the directors.

Subjected to this analysis, the reality of scientific freedom in the United States emerges as something less than a perfect sphere floating in space. It is seen to be relative and conditional and certainly not without plan—the plan of the individual scientist to do a particular piece of research to get a better job; of the university to fulfill a contract and perhaps win an endowment; of the corporation to produce a gadget and make a profit. It is on this freedom, limited and conditioned—not on an entity abstract and perfect—that the functions of the Commission will impinge. Having established this point, we are in a better position to assess realistically the effect of the Commission's operations in this field.

Research Planning by the Commission

Viewed in this context, the work of the Commission will be seen to increase rather than limit the freedom of scientific research. Its powers to support and conduct research should broaden the scope of science and increase the range of choice open to the individual scientist.

To accomplish this objective the Commission has no power to coerce or to punish; it has no means to dragoon or to regiment. Rather, its power to issue regulations in the interest of public health and safety and to inspect to be sure these regulations are complied with is an unexceptional exercise of traditional police powers. Its right to require reports concerning all types of research activity merely enables it to keep informed about the whole field of atomic energy research. Its only direct authority over research is the power to issue or withhold fissionable and by-product materials from applicants who desire them for research purposes. Under the Ad-

ministrative Procedure Act * abuse of its powers relating to materials distribution would be subject to review and reversal in the courts. The clear mandate of the Atomic Energy Act is that materials should not be denied for research unless there is a real shortage or the applicant is unfit as a threat to the nation's security.

The Act makes a positive effort to free research so far as possible from all the restraints and controls imposed upon other types of activity in the field of atomic energy.† The report of the Senate Special Committee on Atomic Energy states that "in drafting the bill the Committee has been particularly careful to refrain from inserting prohibitions or restrictions of any nature on scientific research." ‡ Research may be conducted independently, as a consequence of this sound policy, *in any field of atomic energy, even in military applications,* without obtaining any special permit or license from the Commission. The scientist can delve into nuclear physics, develop improved devices for producing fissionable materials, design a superbomb, or, within the limits of his scientific equipment and competence, do whatever his scientific conscience dictates.

To accomplish its objectives, the Commission must depend, for the most part, on exactly the same means that a corporation intent on developing a new product would utilize—that is, the spending of money and the offering of inducements. It is, in effect, a new competitor in a field that has come very largely under the dominance of industry. If the Commission plans wisely, the effect of this competition throughout a generous segment of science should be healthy.

The pressure of competition will be strongest in the enlistment of competent scientists. The number of such scientists is limited, and if the Commission is to see to it that work that otherwise would have been neglected gets done in certain important areas, this in all likelihood will be possible only at the expense of work that normally would have been undertaken by the same scientists under contract with industry. In this competition industry may have the advantage

* 5 U.S.C. § 1001 *et seq.;* especially § 1009.

† A list of provisions of the Atomic Energy Act affecting research is compiled in Appendix D.

‡ *Op. cit.* p. 13.

of funds, but the Commission's position is by no means a weak one.

The policies and activities described may, it is true, reduce the control over a portion of scientific research now exercised by business corporations and make it more difficult for such corporations to have their drafts instantaneously honored within this area. It is difficult to see, however, in what measure the freedom of science would be impaired.

Some of the specific objectives of the Commission's research program may be considered:

Emphasis

Where individual scientists plan fragmentarily, frequently under the spur of economic hardship, and industrial corporations plan for a larger area defined by considerations of profit, it will be the function of the Commission to plan for the whole field in which its responsibilities lie; and its plans may be as broad as the policy objectives of the Act—to protect the national security and to develop the science to the end that the public welfare may be improved and the standard of living of all the people raised. This means, to begin with, that many of the great gaps in fundamental research (in nuclear physics and related subjects) and in important areas of practical application where commercial profits cannot be quickly realized will have to be plugged.

In general it may be assumed that the Commission will leave basic research to universities (or at least to projects in which universities may participate) and focus its own research on the applications of atomic energy. This pattern would accord, more or less, with the experience, the personnel, and the facilities available to each group. It should not be inferred, however, that the Commission has no further responsibility in regard to basic science. Fundamental research in the sciences affected by achievements in nuclear energy—physics, chemistry, biology, medicine, to mention the leading examples—must, if left to private institutions, have strong federal support. Our weakness in basic scientific research has been pronounced, as we have seen above, and it would be a fatal error for the Commission to assume that this kind of research will take care of itself.

Diversification of Sources

In providing financial support for academic research, the Commission must decide on an allocation policy between the larger and better equipped institutions and the smaller ones. As we have said, a part of our folklore has it that many of the greatest scientific discoveries are made in attics, barns, or cellars. Indeed, the belief is not altogether without foundation, since important discoveries, particularly of scientific applications, have, on occasion, been made with little more than homemade equipment. Even in our time of the 3-billion-dollar bomb project, scientific achievements are not always in direct ratio to the funds lavished upon research. To cite only a single example, one learns on good authority * that Professor Yoshio Nishina of the Japanese Institute of Physics and Chemistry, working in Hiroshima, using equipment "worth less than $20," and "without benefit of the Smyth Report," had made considerable progress on the right track and learned much of the fundamentals of the release of atomic energy.

The question of supporting small institutions by research grants is not, of course, one to be settled on sentimental considerations. Talent for scientific research is distributed widely. "Assistance should go where the good men are," as Harlow Shapley has said, "even if their equipment has been scanty and their professional experience limited." Both large and small academic institutions can and must contribute to the advancement of science. Universities with large endowments usually have laboratories, facilities, and experience suited to research in basic and applied science. The larger institutions inevitably attract men who have established their reputations as scientists and developed their own staffs. On the other hand, support for the smaller institutions has a direct bearing on the future of science in the sense of encouraging the development of fresh scientific talent. Obviously the large institutions possess no monopoly of such talent. Young, obscure workers in small and isolated academic institutions throughout the country should be made to feel

* Dr. Philip Morrison, now at Cornell University, one of the younger scientists formerly associated with the Los Alamos bomb laboratories and a member of the first bomb survey mission to Hiroshima, in an address to the Institute on World Control of Atomic Energy.

that their researches will not be neglected and that, if their work merits it, they can expect support from the government. Harold Ickes said in his testimony before the Senate Subcommittee on War Mobilization, "The measure of what an institution can do—in science as well as in many other fields—frequently lies not so much in its material possessions as in the wisdom, zeal and vision of the men who serve and love it."

Recruiting and Training of New Scientists

The Commission must realize that at least a part of its expenditures for research must be made on the same broad basis as expenditures in the general field of education. This means a policy consciously directed toward the enlargement of our reservoir of scientific talent as well as toward the subvention of research projects as such. The duty falls more heavily on the Commission in the absence of a central federal research agency, which, presumably, would have this as one of its main functions.

The Commission will find that one of the most significant improvements it can effect is to make it possible for young scientists to live while pursuing research of a noncommercial sort. Its authority to make arrangements and to finance projects is sufficiently flexible to permit such a program.

The Commission's critically important function of developing new talent is closely related to its support of basic research and of small institutions. Educational and training programs often require project assignments, usually noncommercial in kind; and the best means to provide more scientists is to broaden the base of institutions at which they can be trained. The Commission should use its full powers and its funds to this end. A broad and constructive program, wisely planned and effectively administered, must not only advance the science of nuclear physics but result in the enrichment of all the sciences.*

* According to the report (vol. 1) of the President's Scientific Research Board (see footnote on p. 182), during the period 1940-1947 "the national research and development budget increased 335 per cent, while the supply of trained man power was expanding only 35 per cent" (p. 16). See further pp. 16-23 for discussion of the effects of man-power shortages. Among others, the

Long-term Projects

The promise of science is boundless. But unlike the promises of the law merchant, a scientific promise is not payable at a given place or on a stated date; and certainly the promises of science are not payable on demand. Research done in the United States may come to fruit in Denmark. A problem in hydrodynamics solved by an obscure worker in India may result in the invention of a better jet plane in Switzerland. It is both relevant and illuminating to recall the case of atomic energy: The work of Fermi in Italy, of Hahn and Strassmann in Germany, of Rutherford and Chadwick in England, of Becquerel and Curie and Joliot in France, of Bohr in Denmark, of Einstein in Switzerland—the work of all these scientists done over a period of half a century and in six European countries—went into the atomic bomb constructed in the United States by an international group of scientists and American engineers. One of the leading postwar developments in atom-smashing devices is the synchrotron, invented simultaneously and independently by Veksler in Russia and McMillan in California.

It happens now and then that research of fundamental significance is completed within a few months, and sometimes practical applications of a new discovery can be perfected within a few years (the winning of atomic energy is a spectacular case in point). But a very large part of scientific research that shows ultimate results of far-reaching significance requires extended periods for fruition, and often the embodiment of the new discovery in some useful device may be even further delayed, as we have already pointed out. One of the most important tools of modern science and an almost indispensable one to nuclear physics is quantum mechanics, which owes its existence to the great work of the Irish mathematician, Sir William Rowan Hamilton, more than a century ago. This is a tenuous and highly fortuitous chain of development and one that no industrial enterprise would undertake to finance. And yet it is

report concludes (pp. 23-23), "Our national research program is unbalanced in the direction of military research and of applied or developmental research" and this unbalance cannot be "redressed" if military research is to be maintained, because the supply of trained man power "is not adequate for expansions of the magnitude required."

not unrepresentative of the manner in which science has achieved some of its major triumphs.

These considerations are important to the Commission's research policy—the establishment of a proper balance between long-term and short-term projects as well as between pure and applied research. The task of effecting a program that will give adequate weight to long-term projects will not be an easy one. Apart from the intrinsic difficulty of assessing the value of projects whose function will be speculative and long deferred, the Commission will have the further difficulty of convincing the pragmatists of the Congressional Appropriations Committee of the correctness of its assessment—of justifying large expenditures for projects that have no popularly comprehensible results. Nevertheless, the Commission must be firm in its determination to support long-term projects in fundamental science, even where the hope of concrete achievements is far removed, for without this foundation work science must inevitably degenerate to the mere proliferation of gadgets.

Promoting Interchange of Scientific Information

Publication Service

It is altogether clear that some of the most notable achievements of science have sprung from sudden, surprising, and unpredictable cross-fertilizations. An idea conceived in France is expanded into a theory in Switzerland, corrected and elaborated by a scientific apparatus designed in England, and brought to practical fulfillment in the United States. This hypothetical sequence is entirely representative of normal developments in the realm of scientific research, and part of the delay in the fruition of scientific discoveries is the period of time required to complete the largely fortuitous series of couplings in the full circuit.

The Commission can do much to speed the progress of research in nuclear physics and the utilization of atomic energy by helping to improve and keep open the channels of communication between scientists. If our scientists are to work at maximum effectiveness,

they must have full and rapid access to the results of research conducted in this country and abroad. The number of scientific papers, digests, reports, and publications increases every year. The last edition of the *World List of Scientific Periodicals* recorded over 33,000 different titles. Even a scientist working in a highly specialized field faces a Gargantuan task in keeping up with the current literature. Yet, if he should fail to keep himself thoroughly informed, he may overlook a fragment of information on which the value of his own work entirely depends.

The dimensions of the present problem of communication in science is well summarized in the testimony of Watson Davis, head of Science Service and president of the American Documentation Institute, before the Senate Subcommittee on War Mobilization:

> The backlog of scientific knowledge unpublished, unabstracted, unindexed, and in the case of foreign material, untranslated, is tremendous and beyond the ability of existing scientific organizations to handle. In part, this is due to war research now about to be released; in part, it is due to the accelerating pace of scientific inquiry. Fortunately, we have new methods and mechanisms worthy or capable of being developed that can be applied to this important task.*

The technique of microfilming has substantially increased the accessibility of scientific data, especially those contained in library collections of books and periodicals. But scientific data are accumulating so rapidly that mechanical devices that merely facilitate distribution and storage of printed materials are by no means a complete solution. What are needed, as Davis pointed out, are "new mechanisms, which in effect wed the microfilm camera to a selecting mechanism. . . ."

Under Mr. Davis the American Documentation Institute has developed the scheme of "auxiliary publication," consisting of de-

* For a summary of Mr. Davis's testimony see Science Legislation (Analytical Summary of Testimony); Appendix to Report from the Subcommittee on War Mobilization to the Committee on Military Affairs, United States Senate. Pursuant to S. Res. 107 (Seventy-eighth Congress) and S. Res. 146 (Seventy-ninth Congress), Subcommittee Monograph No. 5, Seventy-ninth Congress, First Session, December, 1945. This is a valuable compendium of over 1,000 printed pages of testimony by 100 witnesses appearing before the Senate Subcommittee on War Mobilization on the subject of science legislation.

positing in a central place scientific manuscripts, which are then abstracted and published in the appropriate journals. A reader who then wants a copy of the original can order a microfilm from the central depository.*

A similar procedure has, in one instance at least, been adopted by the Federal government. During the war valuable scientific data were produced by various federal agencies engaged in research. In addition, quantities of material were collected after the invasion from laboratories and industrial concerns in enemy countries. Until the war ended most of the data thus accumulated could not be publicly disseminated because of security requirements. Under authority of Executive Orders 9568 and 9604 the Office of the Publication Board was established in the Department of Commerce and entrusted with the task of making this information publicly available after declassification. This Office has published many abstracts of scientific and technical information and made available microfilms and photostats of the originals. The sustained demand for these materials indicates the deep interest on the part of industry and academic institutions.

In seeking to perform a similar function with regard to unrestricted atomic energy information, the Commission may experience some difficulty arising from the legislative history of the Atomic Energy Act. The Senate bill expressly authorized the Commission to maintain information services, libraries, and other registers of information useful to workers in the atomic energy field. This provision was stricken on the floor of the House on the ground that it would direct the Commission "to set up the biggest propaganda agency ever created by Congress." † Apart from this history the Commission would appear to have adequate authority to make information available under its general powers, in the research and information sections, and in the policy declarations in the Act [Sections 1(b)(2), (3), 3(a), 10(a)(2)]. In practice the Commission should adopt some method similar to the Publications Board system, designed to operate so far as possible on a self-

* *Op. cit.*

† Congressional Record (July 19, 1946), p. 9606.

supporting basis, with a minimum of emphasis on formal Commission organization in this field. It is a reasonable inference from the general tenor of the Act and the history of this particular provision that the Commission may go quite far in assisting nonfederal dissemination of information but must proceed somewhat more cautiously in direct publication by the Commission.

Personal Contacts between Scientists

Communication between scientists cannot be maintained adequately by published papers alone. "Almost every visit of a scientist from one laboratory to his colleagues in another results in the introduction of a new piece of information or point of view that no amount of reading had managed to effect," writes Bernal.* "Partly, of course, this is due to the existing plethora and confusion of publication. But, even if this were removed, there would remain techniques which are impossible to transmit without visual demonstration, and ideas too intangible to be put into writing yet capable of communication by personal contact."

Generally speaking, there are several steps that the Commission may take to encourage and promote personal contacts between scientists. As part of an over-all plan, it should encourage the visits of scientists within our own country from one laboratory to another. It should not only entertain the requests of scientists for funds to make travel possible, but suggest and make possible meetings, seminars, conventions, demonstrations, and similar activities that will bring scientists having mutual interests together. Support of these activities, it is hardly necessary to point out, must not be confined to leading scientists but should be particularly encouraged and supported for the younger men to enable them to enrich their experience.

In discussing the control of information in the next chapter, we shall examine with some care the limitations imposed by the Act

* J. D. Bernal, *The Social Function of Science* (Macmillan, New York, 1939), p. 303.

on the exchange of information between scientists, nationally and internationally. As will appear from that discussion, the greatest danger by far in the matter of exchanges between scientists lies in a policy of unreasonable and unreasoned secrecy, a policy that may end by defeating the very purpose it was expected to serve—the maintenance of American leadership in the field of atomic energy.

10. Control of Information

He that keepeth his mouth keepeth his life; but he that opens wide his lips shall have destruction.

Proverbs, 13:3

To be able to think freely, a man must be certain that no consequences will follow whatever he writes.

Ernest Renan, *L'Eglise Chrétienne*

To be governed is to be watched, inspected, spied upon, directed, law-ridden, regulated, penned up, indoctrinated, preached at, censured, commanded, by beings who have neither title, nor knowledge, nor virtue. To be governed is to have every operation, every transaction, every movement noted, registered, counted, rated, stamped, measured, numbered, addressed, licensed, refused, authorized, indorsed, admonished, prevented, reformed, redressed, corrected.

P. J. Proudhon, *Confessions d'un revolutionaire,* 1849

A secret may be sometimes best kept by keeping the secret of its being a secret.

Henry Taylor, *The Statesman,* 1836

In the year 1633, Galileo was summoned by the Office of the Inquisition from Florence to Rome, there to submit himself to a catechetical examination by a court of cardinals. The heresies of which he was "vehemently suspected" pertained to doctrinal matters, though scientific rather than religious or political. Galileo had advocated and extended the forbidden cosmology of Copernicus and had, in effect, discredited the "official" cosmology of Ptolemy.

The outcome of this historic event is well known: Galileo was forced to abjure his heretical opinions; but the Inquisition treated him "with a consideration unexampled in its history," and the punishment inflicted upon him was comparatively mild. Science had all but won the freedom that it was shortly to attain and was to enjoy

in increasing measure for two centuries while it grew powerful in influence and opulent in prestige.

In the main this freedom was established as a by-product of the process by which other freedoms—of religious worship, of speech, of the press, of assembly—were won. The crucial battles were fought on other fronts, and the freedom of scientific communication emerged as a natural corollary of the general principle established in this struggle—that neither lay nor ecclesiastical authorities could impose their conformities on the conscience and critical intelligence of man.

By the middle of the nineteenth century the general cause of freedom seemed definitely won, and if the principle was not universally established, it was at any rate firmly in the ascendant. To be sure, there were interludes of shadow and eclipse. In the realm of science, facts, the "fortifications of reason," were not always sufficient bulwark against the forces of bigotry and reaction. But on the whole, progress was steady, and the persistence of doctrines which aimed valiantly at the petrification of institutions and the fossilization of thought was viewed as a minor aberration certain to be corrected in time.

The rise of the fascist dictatorships ended once and for all whatever complacency we had on this score. The scope of their triumphs, the bitterness of the battle required to defeat them, the legacy they left behind them, all warn us that freedom is not a gift that, once won, can be taken for granted.

Measures for the suppression of fundamental freedoms, imposed with such ruthlessness and such efficiency by the fascist states, were all justified in the fascist philosophy by the transcendent importance of the nation. In a world reduced to a struggle to the death between competing national organisms, there was no room for the individual conscience, no excuse for personal dissidence, no reason but reason of state. Any dissent from the single will of the leader who alone divined the ultimate goal of the state was held to be weakness, and when nations must struggle ceaselessly for survival, weakness is fatal.

Amid the general destruction of individual freedoms that this

philosophy encompassed, scientific freedom was not spared. Science was dragooned and regimented and made to serve the master's ends. Scientists either made their terms with the state or suffered expulsion or liquidation.

Indeed, when men believe the existence of their society to be at stake, no other fate for dissenters is possible. When the democracies embarked upon total war, the measures they felt it necessary to take in ordering science and circumscribing communication among scientists were scarcely less complete than those imposed by the fascists. In both world wars, the scientists of the United States, of the United Kingdom, and of other democratic countries had to accustom themselves to work under regulations of secrecy in an atmosphere of darkness.

The fact was brought out clearly in an address before the National Academy of Science by Sir Henry Dale, former president of the Royal Society of England: *

. . . in 1918, most of the scientists, like most of the warriors, returned joyfully to normal life and normal standards with the hope that such a call would never come again. When this hope proved vain, the call was for science and scientists as never before, to meet the new threat from an enemy who had already enlisted most of the science of his great nation in secret preparation for an attack on the world's freedom. And to meet this menace, we free peoples found ourselves obliged to submit again to the invasion of our scientific activities by secrecy, to a degree beyond any which had so far been regarded as possible. Secrecy percolated into domains which all earlier wars had held sacred; so that we, for example, whose work was in the medical sciences, found ourselves involved in an inconsistency, which still paid a conventional respect to that immunity of medical equipment and personnel which a more scrupulous age had established, but compelled us, in the name of total war, to throw a veil of secrecy over the new discoveries which could make their work of mercy really effective. To all this and much more we loyally submitted. And now that science has done its part, and the war has been won, we look for the freedom that victory was to insure. Do we find it? Or do we find science still wearing its wartime fetters, in the interests

* Pilgrim Trust Lecture, "The Freedom of Science," Washington, D. C., October 22, 1946.

of a right assumed for any nation, at peace, to make secret preparation for the destruction of its neighbors? . . .

The melancholy observations of Sir Henry are completely justified by the information section of the Atomic Energy Act. If the Act does not restrict the liberty of scientific thought, it without question abridges freedom of scientific communication. The controls on information were deliberately designed to regulate the interchange of scientific ideas; to prescribe when and how a scientist may publish or otherwise communicate the results of his work. And the penalties for violation of these prescriptions are drastic. The data whose communication the Act seeks to regulate are not exclusively technical and military in character nor are they necessarily data compiled by federal workers utilizing federal funds. Even those data describing the phenomena and laws of the visible universe are under interdict; and even data independently arrived at in private laboratories are likewise subject to ban.

It might appear at first glance that this restriction on intercourse between scientists, even in those matters relating to fundamental research and the laws of nature, does not signify greatly for the maintenance of those political freedoms we regard as the most precious part of our heritage. Even a hasty analysis will reveal, however, that no such conclusion is justified.

The provisions under discussion cannot be viewed as isolated phenomena; they are significant primarily as symptoms. For the reason that has prompted this assault on a citadel of freedom firmly established for centuries is more important than the assault itself. This reason, of course, is fear for the nation's security in a world that has mastered the technology of instantaneous mass annihilation.

If national safety is now held to require a radical abridgment of the freedom of communication among scientists, it may be held to require the abridgment of other freedoms as well. For if wars are total and the threat of destruction absolute, is there any stopping point short of total preparedness and absolute supervision over all activities that threaten the state? The feverish images already in-

voked in the discussions of the control of atomic energy give a foretaste of possible legislation. Atomic bombs can be smuggled in suitcases and assembled clandestinely in sizes to destroy a metropolis. Wars in our age being ideological as well as national, we must guard as vigilantly against the fifth column as against external dangers. Fears of this sort feed on one another. Unless they can be checked at the source, they must inevitably evoke repressive measures that will go far beyond the interdiction of scientific communication.

If we are straining every nerve to keep from our suspected enemy weapons we fear he may use to destroy us, we are hardly likely to tolerate the dissemination among us of doctrines even remotely identified with his ideology. If one traitor can engineer the death of millions, the procedural safeguards that protect the accused from unjustified punishment must be relaxed lest that one guilty man go free. If we are unable to move effectively against external dangers, in our fear and frustration we will be susceptible to the temptations of witch-hunting at home.

If this prognosis is correct, the information section of the Atomic Energy Act is principally significant as symptom and warning. So long as the terrible danger of national destruction persists, it is clear we must take such measures as we can to protect ourselves against it. But we must recognize at the same time the dangers to the fundamental values of our system that are implicit in an uncritical policy of placing immediate security considerations before everything else. If we are determined to do our utmost to preserve individual freedoms, we will scrutinize all measures that purport to serve security purposes at the expense of individual liberty and reject those that do not appear to be essential and well designed to serve their intended purpose. While we must accept the basic proposition that we should have all the controls over atomic energy that contribute to our security, this does not mean that we are not justified in asking pointed questions about the nature and the probable effect of each of the specific controls proposed.

Information Controls and Scientific Progress

We have pointed out in the foregoing chapter that science depends on the free flow of ideas between scientists the world over. Every scientist builds on the achievements of his predecessors and contemporaries: most often his own work is brought to fulfillment by the work of his successors. This life-giving flow of ideas is assured by the freedom to publish, to communicate, to exchange views by personal contact.

The winning of atomic energy was a scientific and technological achievement to which scientists from so many different countries contributed that it may be regarded as a prototype of international cooperation. Moreover, it is unique proof of the complete interdependence of all scientific activities. Any measure, therefore, that disrupts this symbiotic relationship among scientists harms the organism of science by impeding its natural function and retarding its growth.

One of the principal difficulties in controlling the dissemination of scientific information arises from the fact that controls, however skillfully formulated, cannot be made sufficiently flexible or selective. This is a flaw characteristic of legal machinery, although it arises not infrequently in other disciplines. In medicine, for example, the conquest of a particular disease often hinges on finding a drug that will destroy the bacillus but not the patient.

To safeguard information against coming into the possession of foreign scientists requires controls that inevitably restrict the free exchange of scientific ideas among our own scientists. Thus, while it may be possible to reduce leakages to countries that may be our enemies in future wars, this cannot be achieved without restricting the flow of information at home.

Is it possible to find a middle way that science and national security can travel together without seriously impeding each other in their journey? Many of our leading scientists believe not.

A well-known physicist,* testifying before the Senate Special

* Louis N. Ridenour, Professor of Physics, University of Pennsylvania, Hearings before Senate Special Committee on Atomic Energy, Pursuant to S Res. 179, Seventy-ninth Congress, First Session, 536 (1945).

Committee on Atomic Energy gave an account of wartime experience in the development of radar that may be not without a moral for atomic energy:

> In the radar field, we started with the same atmosphere of secrecy, the same precautions about compartmentation of information and clearance of individuals, which characterized the atomic bomb project right to the end, and still characterize it today. However, we did away with most secrecy before the end of the war. At the end of the war the Army was publishing a magazine on radar with a circulation of over 12,000. It had become by that time apparent that secrecy cost in efficiency far more than it gained us by keeping the enemy in ignorance.

Can Scientific "Secrets" Be Kept?

The question remains, have information controls any value? Can they be enforced? Since this is open to serious doubt, it may be that the point should have been considered at the outset. For if we have no secrets to keep—or if we had any, they could not be kept—other aspects of the matter become more or less academic. Thus our presentation of the issues may come perilously close to Bertrand Russell's sad example of compound arguments: "I was not drunk last night. I had only two glasses of beer. Besides, it is well-known that I am a teetotaler."

To begin with, what subjects can effectively be kept secret? The Concise Oxford Dictionary gives as examples: "treaty, understanding, errand, door, passage, sin, process, arrival, influence." The facts about the physical universe are evidently not included. Mr. Churchill has referred to the release of atomic energy as a "secret long mercifully withheld from man." The expression is as felicitous as it is eloquent. For the secret has been withheld from *man,* meaning all men, not merely Germans, Frenchmen, Russians, or Puerto Ricans.

The use of the word "secret" for the results of scientific investigations is unfortunate and misleading. A dream or an unuttered idea are examples of things that can be kept secret; if their possessor does not choose to reveal them, they remain so.

On the other hand, if I say, "I know the critical mass of U-235 necessary to make a bomb, and I intend to keep it secret," I am using the word "secret" in an entirely different sense. I am saying to you, not that you cannot find out what I know, but that you must find it out for yourself, without my help. This may cause you to become annoyed with me, but it cannot keep you in ignorance.*

This is not to say that restrictions on the disclosure of new basic discoveries or of technical processes such as those involved in separating the isotope U-235 may not lengthen the period required by other nations to learn this information. So the question becomes not, "Shall we keep the secrets of atomic energy?"—that is impossible—but rather, "Will the control of atomic information in the United States delay other nations enough to warrant the resulting impairment of our own research and of international comity?"

In reaching a judgment on this question three factors must be taken into account. First, it is essential to recognize that, once it is disclosed that a technical device has been developed in one country, even if details regarding it are held secret, the search becomes easier for other countries. The knowledge that a problem is, in fact, possible of solution is an important aid to others seeking a solution, both in a psychological sense and in helping to eliminate fruitless lines of inquiry. This applies to fundamental as well as applied research and was well illustrated in the development of atomic energy. Once it became known that a chain reaction could be sustained, that the neutron "reproduction factor" could be made to exceed 1, or that U-235 could be separated by various methods in substantial quantities (all of which was officially established in the Smyth report), the task for other countries seeking to develop their own methods for releasing atomic energy was perceptibly lightened. They had assurance that the problem could be solved and were able to concentrate their efforts on approaches of proved value. The point is well though perhaps somewhat naïvely brought out by an incident famous in the history of science; it relates to a visit paid to John Napier, soon after his invention of logarithms, by Henry Briggs, then (1614) professor of geometry at Oxford.

* Ridenour, *op. cit.*, p. 537.

Briggs's first words were: "My lord, I have undertaken this long journey purposely to see your person, and to know by what engine of wit or ingenuity you came to think of this most excellent help in astronomy, *viz.* logarithms; *but, my lord, being by you found out, I wonder nobody found it out before, when now known it is so easy.*"

Second, the general principles underlying all technical processes are likely to be widely known, being derived usually from some discovery of basic science. For example, the cascade principle used in the successful gaseous diffusion method of separating U-235 is a well-established idea, based on scientific advances to which Lord Rayleigh and Aston made major contributions well before World War I. Thus, it is only the latest improvement or modification of an existing technique that can be held in camera, and then only for an indeterminate but usually brief period. Moreover, there is no likelihood whatever, with all our preeminence in technology, that the disparity between the level of our technical competence and that of other industrialized countries—at least half a dozen could be named (*e.g.*, Great Britain, Canada, Russia, France, Sweden, Czechoslovakia)—is such that the latter would be more than, at most, a few years behind us. Indeed, there is abundant evidence that other nations frequently develop technological methods and processes distinctly superior to ours in a variety of fields. Even wholly new processes are likely to be already known or simultaneously discovered in other countries. For intellectual progress, especially in the sciences, is more or less uniform in countries that for generations have shared the same cultural climate. Only a small fragment of our own scientific ideas is likely to be original, and that fragment is likely to be of little value by itself. One would not assume that biological evolution functions differently in Des Moines, Copenhagen, and Moscow. The likelihood of marked differences in the evolution of scientific thought corresponding to geographical differences is equally small. Doubtless some nations show special aptitudes in one field, some in another, but the community of science has long been international and the objects of its search are universal.

On this point we again have the testimony of Louis Ridenour: *

This is really the crux of the argument. If we can hide nothing permanently by scientific secrecy, then it is clearly undesirable, for it slows our own progress. Scientific history is full of coincidences—of cases in which two or more men, in different parts of the world, have reached the same result and independently of one another's work and at the same time. Dr. A. H. Compton, an outstanding figure in the work on the atomic bomb, was awarded the 1927 Nobel prize in physics for his discovery of what is now called the Compton effect—the inelastic scattering of light quanta by free electrons. In Holland, this is called the Debye effect, because Compton's explanation of his experiments was given independently by Debye at the very same time.

The Russian physicist, Gamow, and Gurney and Condon—the same Dr. Condon who is scientific adviser to this Committee—gave independently and at the same time an explanation of the phenomenon of alpha-particle disintegration of the radioactive elements. The very phenomenon of nuclear fission itself, the basis for the atomic bomb, was only foreshadowed by the work of Hahn and Strassmann in Germany. The hypothesis of a violent splitting of the uranium nucleus was independently proposed and verified by Frisch in Copenhagen and by Joliot in Paris. The suggestion that plutonium would be a suitable explosive for an atomic bomb was made in this country by Prof. L. A. Turner. The Smyth report points out that the same idea occurred independently to the British physicist Cockcroft, and Turner has told me that Von Halban, working in France, had the same idea at the same time.

Two promising new devices for the acceleration of electrons and atomic nuclei to high energies were invented last fall by two young American scientists. One, called the synchrotron, was invented by McMillan, at Berkeley; another, the microtron, by Schwinger, at Harvard. In the summer, 1945, issue of *The Journal of Physics* of the USSR, a Russian physicist named Veksler published a paper describing these two devices. Though the scientific shades had been down between Russia and the United States during the war, after five years we find Russians and Americans doing the same things, in the same way, at the same time . . .

In my own wartime field of radar there were many examples of the same kind. Radar itself was independently invented by the Germans, the French, the British, the Japanese, and ourselves. Each of these

* Ridenour, *op. cit.*, pp. 537-538.

nations kept it secret from all of the others, not knowing to what little point this was done. Microwave radar, which has played such a great role in the Allied victory, was made possible by a single invention, the cavity magnetron. This is a transmitting tube which gives previously unimaginable amounts of power on wavelengths far shorter than those available to radio engineers before the war. It was invented by the British. When the British sent a scientific mission over to this country in the late summer of 1940, one of the most impressive of the secrets they had to show us was the cavity magnetron. When the radiation laboratory was first set up, an attempt was actually made to keep knowledge of the magnetron localized in one group of the laboratory, not even letting the men who were working on a modulator to energize this tube know of the tube's design. Yet, all this time there was in the Russian literature a paper which exactly described the cavity magnetron, and gave the results of experiments with it.

Finally, the cosmopolitan character of the atomic energy project should not be forgotten. This work was the product of the scientific brains of several of the allied nations, and participating scientists inevitably acquired a considerable measure of the specialized and technical knowledge required to produce the bomb. It must be assumed that any "secrets" known by these scientists, many of whom have returned to their own countries, have been disclosed to fellow-workers in nuclear physics in other parts of the world. The statement of Professor Marcus Oliphant, a distinguished Australian scientist, leaves little doubt on this point. He said that the United Kingdom "knew all there was to be known about producing bombs because her scientists had worked with the United States in the development."

Congress nevertheless decided that the dangers of free speech in nuclear science and related technologies could not be risked. And, having reached this conclusion, there remained the questions: What information was to be restricted? Under what circumstances might United States scientists exchange restricted information? How should violations be punished?

The answers to these questions appear in Section 10 of the Act.

Statutory Statement of Policy

As a preamble to the main provisions of the control of information section, the Act recites two statements of policy, interesting mainly for their political significance.

Exchange of Information with Foreign Nations

Pursuant to the overriding consideration of "defense and security," data on atomic energy with respect to its use for industrial purposes shall not be exchanged with other nations until "Congress declares by joint resolution that effective and enforceable international safeguards against the use of atomic energy for destructive purposes have been established . . ." This is language similar in purport to certain declarations contained in the joint Truman-Attlee-King Statement of November 15, 1945, on the international aspects of atomic energy.*

The statement plainly reveals the determination of Congress to safeguard all the "secrets" of atomic energy—including those relating solely to its industrial use. Since the production of power by nuclear processes requires either the production of fissionable material or the "burning" of fissionable material as nuclear fuel, this appears to be a reasonable position for Congress to adopt. Note, however, that the text under consideration makes no reference to the possible exchange with other nations of technical data relating to other aspects of atomic energy even *after* "effective and enforceable international safeguards" have been established. No undue significance should be attributed to this omission; nevertheless, it reemphasizes the concern of Congress with the protection of the "secret" and its unwillingness at the time to make any commitments as to conditions under which the resumption of free scientific intercourse would be permitted.

To be sure, other provisions of the Act may be thought to contradict this inference. For example, Section 8 provides that if international arrangements for the control of atomic energy are achieved,

* Reprinted in "Report of the Senate Special Committee on Atomic Energy," No. 1211, Seventy-ninth Congress, Second Session, pp. 33-35, 1946.

any provisions of the Act inconsistent with such arrangements "shall be deemed to be of no further force or effect" [Section 8(b)]. But since such arrangements must first have the approval of Congress, it is evident that Congress will have ample opportunity to consider the entire question of exchanging scientific data with other nations and deciding whether such exchange, or the relinquishment of atomic information to an international authority, meets the requirements of defense and security *as then determined by Congress.**

Encouragement of Free Interchange of Ideas

As we have indicated in Chapter 1, American scientists, particularly physicists, throughout the period that the McMahon-Douglas bill was before Congress, made their influence felt not only in public statements but directly in seeking out key members of Congress for the purpose of explaining and urging the point of view of those engaged in research as a profession. While the "atomic scientists," as they called themselves (demonstrating thereby a finer appreciation of the journalists' art than of the niceties of English usage), had a serious interest in the bill as a whole, their closest attention was focused, as might be expected, on the research provisions and on the section dealing with the control of information. Section 10 reveals in several important provisions the success of their advocacy.

For example, Section 10(a)(2) provides that the dissemination of scientific information should be "permitted and encouraged so as to provide that free interchange of ideas and criticisms which is essential to scientific progress." Considered in conjunction with the balance of the section and the general provisions of the Act respecting research, it appears to assert a precept for the Commission of a priority comparable to the other policy directions that are set forth elsewhere in the Act. The existence of this policy statement denies to the Commission the politically comfortable expedient of making defense and security exclusive considerations. Politically safe though such a position might be, its effect would be dangerous to the national security as well as intolerable to the working scientist.

* For a further discussion of the international implications of the provisions governing control of information, see Chap. 12.

Mechanics of the Control System

The actual mechanics of the system of controls over information established by Congress in the Act are quite simple. Certain kinds of information relating to atomic energy are denoted as "restricted data." The Commission alone determines which of the data in the restricted category shall be removed from it and thereafter freely disseminated. As for restricted data, these may not be communicated or transmitted without incurring certain penalties in the event the acts of communication, transmission, etc., are perpetrated "with intent to injure the U.S. or with intent to secure an advantage to a foreign power" or in certain instances where the perpetrator, though innocent of such intentions, has "reason to believe" that injury to the United States or advantage to a foreign power will be the consequences of his action.

While the mechanics are simple, the concepts are not; nor are the interpretation and application of the several provisions free of serious difficulties and dangers. Let us proceed to examine some of the major parts of the control machinery in greater detail.

Restricted Data

This means all data [Section 10(b)(1)] "concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power. . . ."

With caution the dominating consideration, the definition was so constructed as to embrace practically all significant data relating to atomic energy. The manifest intention of Congress was to make the term "restricted data" an all-inclusive category from which the Commission might remove classes of information on its own responsibility and in conformity with the general security standards set forth in the Act.

The first portion of the definition raises no serious problem. Information respecting the manufacture or utilization of atomic weapons is almost exclusively of military value and should ob-

viously be subjected to strict control. The other portions of the definition, however, are not so readily disposed of.

Information about the production of fissionable material, a very loose and broad concept, embraces much that is of general importance to fundamental as well as applied research. If private research in this area is to contribute effectively to the future development of atomic energy, the Commission must do what it can to keep channels of communication open between the laboratories of government and those of university and private industry. The Commission must seek in this area to reconcile objectives of opposite tendency—the maintenance of secrecy and the promotion of vigorous and fruitful research. So long as the present temper prevails, the Commission will feel powerful pressures to refrain from declassifying data until they are generally known, at least in part, as a result of publication of such information by other countries. Tempting as this policy will prove, it is to be hoped that the Commission will reject it, for if the United States publishes little other than what is already known, other countries will follow the same course and the rate of scientific progress will be greatly retarded. The larger the area that is maintained as restricted, the greater will be the responsibility of the Commission to encourage the free exchange of information among our own scientists and between federal and nonfederal laboratories.

The third category of restricted data encompasses "the use of fissionable material in the production of power." This category extensively overlaps that of fissionable material production, and somewhat the same observations apply to both. In the event of an agreement between nations to set up an international development authority, the information function in this, as in other categories, will be altered radically.

Insofar as the fields of atomic power and of fissionable material production overlap, restrictions on dissemination of information relating to the former are obviously justified. However, scientists who have worked in the field have asserted repeatedly that a variety of useful data on power production could be released without the revelation of significant data on the production of fissionable ma-

terial. Consequently, the only justification for prohibiting communication in this area is the fact that it relates to the nation's economic potential and therefore has military significance. There can be no quarrel with the general proposition that economic potential is ultimately convertible into military effectiveness, but if this is the rationale for a policy restricting the dissemination of information, then clearly there are many other elements which must be included as well—coal mining, steel production, electrical engineering, automobile manufacturing, chemicals; the list could be extended indefinitely. The policy followed by the Commission in this area will thus have implications of broad significance, and it is of considerable importance that it should not appear to endorse the principle that data should be withheld merely on the grounds that they relate to the nation's general economic potential and thus ultimately to its military strength.

As indicated above, the three categories of restricted data are sweepingly inclusive in scope. Unfortunately, a detailed enumeration of categories of restricted information was not feasible. Such a catalogue would have been unwieldy apart from the fact that its publication would have revealed certain information that it had been decided must for the present be kept secret. That Congress intended information within the restricted categories to be released at the Commission's discretion is, of course, evident from the express language in the latter part of Section 10(b)(1). The Senate Special Committee, moreover, was at pains to study the declassification procedures followed by the Manhattan District in issuing documents such as the Smyth Report and to incorporate the principles employed in the Act itself.

What areas of information clearly lie outside the scope of restricted data as above defined? Much fundamental information in the field of nuclear physics does not appear to be caught up in the control net. But to dispel doubts and to relieve physicists of the intolerable fear that publication of every research finding is a violation of the Act, the Commission will be well advised to publish explicit and detailed catalogues of types of data *not* included in the restricted category. These catalogues must be kept up to date and

made available promptly to all research laboratories. Exempt information would also include an immense amount of medical data in relation to radioactivity and radioactive substances; technological information on the mining and refining of source materials; data of chemistry, engineering, etc.

Final authority for removing data from the restricted category lies with the Commission.* If another agency of the Federal government should attempt to apply its own interpretation of what data lie within the restricted category, intolerable confusion would result. To guard against this possibility Section 10(b)(6) expressly states that "no government agency shall take any action under . . . other laws inconsistent with the provisions of this section." The Senate Special Committee Report interprets this provision as prohibiting "any agency from placing information in a restricted category under the authority of this *or any other law* once such information has been released from the category by official action of the Atomic Energy Commission" † (italics by authors). (At a later juncture we shall discuss the relation of this provision to the possible range of application of the Espionage Act.)

* There is some legal basis for concluding that publication in any form of such data may operate to remove them from the scope of controlled information. To be sure, the only cases that have been decided arose under the Espionage Act [40 Stat. 217 (1917), 50 U.S.C. § 31 (1940)]. But a judicial holding as to what is and what is not an official secret, the unauthorized disclosure of which justifies criminal proceedings, must be judged as relevant to the interpretation of any statute providing for the control of information in the interest of national defense. In *United States v. Heine* [151 F. (2d) 813 (C.C.A. 2nd 1945)], discussed more fully in Appendix F, the court held that the defendant could not be punished under the Espionage Act for communicating information of military significance to a foreign nation where the information had previously been publicly released or not withheld and therefore was publicly available, even though there was clear evidence of the defendant's bad intent. Relying upon legislative debates emphasizing an intent to prohibit communication only of "secrets," the court interpreted the Act to exclude nonsecret information. From the standpoint of endangering the national defense, once information has been made public, even if unlawfully, assuming the information was really made generally available, the harm, if any, has been done and those responsible for the initial publication should bear the brunt of the punishment.

Even apart from the interpretation announced in the Heine case, it may be unconstitutional to prohibit communication of publicly available information. Secrecy controls rest upon the war powers and may supersede the first amendment guaranteeing freedom of speech only if necessary to the waging of war or the national defense. In *Schenck v. United States* (249 U.S. 47) the Supreme Court rephrased this test in terms of whether or not the prohibited utterances constituted a "clear and present danger" to the nation's safety. It is at least possible that the courts will declare this requirement not met by utterance of information that is already publicly available.

† *Op. cit.* p. 24.

Types of Offenses and the Prescribed Penalties

Having defined "restricted data," the Act proceeds to set forth the actions involving the communication of restricted data, which invoke criminal penalties if committed

(1) with intent to injure the United States,

(2) with intent to secure an advantage to any foreign nation, or

(3) with reason to believe that injury to the United States or advantage to a foreign nation will result from the act.

The prohibited actions are clearly stated and raise no problems of interpretation. They can be disposed of briefly before an analysis of the more difficult problem of the intent with which such actions are committed is undertaken:

A. Whoever communicates, transmits or discloses any "document, writing, sketch, photograph, plan, model, instrument, appliance, note or information involving or incorporating restricted data" under circumstance (1) above shall, upon conviction, be punished by death or imprisonment for life, *provided this be the recommendation of the jury hearing the case.* If the jury *does not recommend* death or life imprisonment, the maximum penalties shall be twenty years' imprisonment and/or a fine of $20,000 [Section 10(b) (2) (A)];

B. Whoever communicates, transmits or discloses any document, writing, sketch, etc. [as in A above], involving or incorporating restricted data under circumstance (2) above shall, upon conviction, be punished by imprisonment of not more than twenty years or by a fine of not more than $20,000 or both [Section 10(b) (2) (A)];

C. Whoever communicates, transmits, or discloses any document, writing, sketch, etc., involving or incorporating restricted data under circumstance (3) above shall, upon conviction, be punished by a fine of not more than $10,000 or imprisonment for not more than ten years or both [Section 10(b) (2) (B)];

D. Whoever, under circumstance (1) above, "acquires or attempts or conspires to acquire any document, writing, sketch . . . [etc.],

involving or incorporating restricted data" shall, upon conviction thereof, be punished by death or imprisonment for life, *provided this be the recommendation of the jury hearing the case.* If the jury *does not recommend* death or life imprisonment, the maximum penalty shall be twenty years' imprisonment and/or a fine of $20,000 [Section 10(b)(3)];

E. Whoever, under circumstance (2) above, "acquires or attempts or conspires to acquire any document, writing, sketch . . . [etc.], involving or incorporating restricted data" shall, upon conviction, be punished by a fine of not more than $20,000 or imprisonment for not more than twenty years or both [Section 10(b)(3)];

F. Whoever, under circumstance (1) above, "removes, conceals, tampers with, alters, mutilates or destroys any document, writing, sketch . . . [etc.], used by any individual or person in connection with the production of fissionable material or research or development relating to atomic energy, conducted by the United States, or financed in whole or in part by Federal funds, or conducted with the aid of fissionable material, shall be punished by death or imprisonment for life," *provided this be the recommendation of the jury hearing the case.* If the jury *does not recommend* death or life imprisonment, the maximum penalty shall be twenty years' imprisonment and/or a fine of $20,000 [Section 10(b)(4)];

G. Whoever, under circumstance (2) above, "removes, conceals, etc." [as in F above] shall, upon conviction thereof, be punished by a fine of not more than $20,000 or imprisonment for not more than twenty years or both [Section 10(b)(4)].

The draconic sweep of these penalties reveals Congress's obsession with the safeguarding of secrets. These unprecedented provisions, which prescribe the death penalty in peacetime even for such an offense as "mutilating" a "sketch" relating to atomic energy research partially financed by federal funds, can be ascribed only to superstitious dread. Terror of the atomic bomb is natural and understandable—perhaps even healthy—but terror at the loss of the "secret" is a tribal and superstitious fear that, once gaining ascendancy in our minds, must inevitably weaken rather than strengthen

our defensive power as a nation. Preoccupation with the "secret," instead of with the thing itself, will stifle the scientific research from which our real strength is derived, will strengthen the pernicious misconception that we have a monopoly of knowledge in the science of atomic energy, and will beguile us into embracing the fatal fallacy that we can achieve security for ourselves by keeping our knowledge from others.

Prohibitions A, B, and C are directed against the communication or transmission of information orally or in documentary form. The penalties of death or life imprisonment are evidently reserved for the most flagrant offenses and require an express recommendation by the jury. Note, however, that the death penalty (or life imprisonment) may be meted out even in peacetime. This contrasts sharply with the penalties of the Espionage Act—a maximum of twenty years' imprisonment—for similar offenses under similar circumstances. Note further that the prohibition applies to illegal traffic in restricted data *whatever* their source—whether produced on federal projects or in private laboratories. Assume the case of a scientist "A" working in a government laboratory, who, having gained access to restricted data, passes the data on to "B" with intent to injure the United States or give advantage to a foreign power. "A" will be prosecuted and may either suffer imprisonment up to twenty years or, in the extreme case, the jury may recommend the sentence of death or life imprisonment. The penalties are severe, but they are probably justified by the nature of the crime—a treasonable act on the part of a public servant entrusted with official secrets.

But assume that "A" is a scientist working in a *private* laboratory, has no official connection with the government, and uses no federal funds. Suppose that he makes a discovery independently and publishes the results, and that these results incorporate restricted data. If at his trial the jury finds that publication of the data was with intent to injure the United States, he also may receive the death penalty or life imprisonment if the jury so recommends.

Either the government scientist or the private scientist may receive a maximum sentence of ten years' imprisonment for committing the

offense described above *without* any specific intent to injure the United States if it appears that he had reason to believe the act would result in injury to the United States or benefit to a foreign power.

In effect, the Act abolishes to a considerable degree previous distinctions between public officials and private individuals and between "official secrets" and data independently arrived at.

Prohibitions D and E are directed against the acquisition or attempt to acquire restricted data orally or in documentary form. The penalties are the same as for transgressions of the A, B, and C types above except, of course, that no one may be convicted of these offenses unless actual intent to injure the United States or give advantage to a foreign power is proved. Constructive intent, *i.e.*, "reason to believe," etc., will not suffice for a conviction.

Prohibitions F and G rest on a hybrid concept partially related to restricted data and partially to what might be called sabotage. Again, it seems reasonable to make punishable the offense of mutilating, altering, destroying, etc., plans, models, documents, instruments, etc., incorporating restricted data and representing the fruits of nuclear research in government laboratories, although the death penalty seems an unduly severe measure to apply. But to make the same action a capital offense under certain attendant circumstances, even when committed in a private laboratory, seems to reflect an unreasoning fear bordering on hysteria.

The Problem of Intent

Intent to Injure the United States

What is meant by committing an act "with intent to injure the United States"?

The phrase unfortunately is no palimpsest, yielding unsuspected meanings upon careful analysis. Read in the present context, an intent to injure the United States is presumably an intent to weaken its relative military strength by communicating data of military significance to a potential enemy. It is not certain whether this

includes economic data or, if it does, what range of such data. The answer must await judicial determination.

Unfortunately, the precedents are meager and perhaps not even in point. Decisions under the Espionage Act, which uses language similar to the present Act [*e.g.*, "with intent or reason to believe that the information is to be used to the injury of the U.S., or to the advantage of any foreign nation . . . ," 40 Stat. 217 (1917), 50 U.S.C. § 31(a) (1940)], do not adequately illumine the point. As may be seen from the discussion in Appendix F, the debate in Congress over the Espionage Act seemed to indicate the general belief that the word "injury" related solely to military injury.* But this really brings us little further. A military injury is presumably an injury respecting military plans or equipment. But what, in turn, are these? It must be conceded that decisions under the Espionage Act are of limited weight in interpreting terms used in the Atomic Energy Act. This is the case partly because it was the clear intent of Congress, as evinced by the drastic penalties alone, to treat atomic energy as a category special and unique; partly because in the Espionage Act "restricted data" does not receive even the loose definition accorded it in the Atomic Energy Act (the term there used being the very vague compendium, "information respecting the national defense"); and finally because, as indicated in Appendix F, the Espionage Act is plainly intended to protect only what might be termed official secrets. Nevertheless, the influence of the First Amendment to the Constitution in interpreting the Espionage Act is likely to be felt also in the judicial definition of "intent" under the Atomic Energy Act.

Intent to Benefit a Foreign Nation

Linked with the concept of "intent to injure the United States" is that of "intent to secure an advantage to any foreign nation." Even before the "one world" concept came into vogue it might have been argued that any act that gives advantage to a foreign nation in the sense of strengthening its military potential would create a balance

* See 54 Congressional Record 3595 (1917).

of military power less favorable to the United States and thus constitute an injury to this country.

In the Heine case,* already referred to, Judge Learned Hand indicated that the phrase "injury to the United States" in the Espionage Act does not appear as broad as "advantage to a foreign nation." He wrote, ". . . while it is true that it is somewhat hard to imagine instances in which anyone would be likely to transmit information . . . which would be injurious to the United States, and yet not advantageous to a foreign power, it is possible to think of many cases where information might be advantageous to another power, and yet not injurious to the United States." In this we have one of the few guideposts, if judicial precedents under the Espionage Act can be so considered, to the scope of the phrase "advantage to any foreign nation."

The Atomic Energy Act indicates on its face that Congress used the phrase "intent to give advantage to a foreign nation" to connote a less grave circumstance in connection with unlawful dissemination of restricted data than "intent to injure the U.S." For an offense to be punishable by death or life imprisonment the Act requires it to have been "committed with intent to injure the United States" [Sections 10(b)(2)(A), 10(b)(3), 10(b)(4)]. The legislative history of the Atomic Energy Act does not contribute significantly to the determination of this issue. The Senate Special Committee rejected the proposal to modify the phrase "advantage to any foreign nation" by inserting the word "military" before "advantage." † From this it may be inferred that "advantage to any foreign nation" is not to be regarded merely as an alternative or reciprocal method of expression for "injury to the United States" if the latter is construed as meaning "military" injury.

This conclusion contributes to the interpretation of the phrase "advantage to any foreign nation." It is manifestly impossible to prove "intent," *i.e.*, a state of mind, except by outer, observable circumstances. In the problem under discussion this applies to either kind of intent—the intent to injure the United States or the intent

* 151 F. (2d) 813 (C.C.A. 2nd 1945).
† See New York *Times*, May 2, 1946, p. 5, col. 4.

to give advantage to a foreign nation. Now, if we reflect on the matter for a moment, it becomes clear that objective evidence of intent to give a *military* advantage to a foreign nation is most likely at the same time to be evidence of intent to injure the United States militarily. It is permissible therefore to infer that it was not the intention of Congress to exempt from the death penalty or life imprisonment anyone who communicated information with the intent of giving a *military* advantage to a foreign nation. Exceptions to this rule of thumb are wholly conceivable but are not likely to have practical weight in judicial proceedings. We may note, as one example, the case of the British scientist Alan Nunn May, sentenced to prison in 1946 for transmitting to a foreign, *i.e.*, non-British, nation restricted information of military value relating to atomic energy. May readily confessed to the charge but in defense advanced the right of scientists of all nations to communicate freely and made certain other points along this general line. Under the Atomic Energy Act it would have been possible for May's counsel to argue that, while May had intended to give valuable military information to a foreign nation and thus to confer a military "advantage" on that nation, it was not his intention to "injure" his own country. But it is doubtful, to say the least, whether this argument would have persuaded either court or jury in May's favor.

This leads quite naturally to another inquiry. Suppose that the "foreign nation" that the defendant in a given case is accused of having advantaged is regarded by the United States as a friendly nation, one that it is safe to anticipate would neither betray the information thus gained to a nation "unfriendly" to the United States nor, in the event of a future war, would be other than our ally. May the court or jury take notice of this fact of *Realpolitik* and thus conclude that the offender under no circumstances intended to "injure the United States"? Might this fact be regarded as a complete excuse of the defendant's offense? In other words, is the giving of an advantage "to any foreign nation" to be considered in light of which foreign nation actually was the beneficiary of the advantage? It is unlikely that the courts would go so far in construing the phrase, yet one may venture the guess that the punishment for

the offense would be mitigated considerably if the foreign nation to which the information was given were a "friendly" or "popular" or "nonaggressor" nation as against a nation not so regarded.

Now if intent to give a military advantage to a foreign nation is almost tantamount to intent to injure the United States, what are the less grave circumstances which Congress intended to fall within the "advantage" category alone? In considering this point one may speculate that useful economic data would be interpreted as conferring an advantage on a foreign nation, especially economic data relating to atomic power. It is less likely that information in such categories as, say, medical or cultural data would be included unless there were some clear military or economic significance attached to the data revealed. So much is reasonable to predict; beyond that, it will depend on the prevailing political climate, on the state of international relations, on the effect of these on the judicial process, and on the policies of the Commission in interpreting the definition of restricted data and in removing data from this category.

"Reason to Believe"

Certain offenses, as will be remembered, are punishable even if there is no evidence of intent of either type, so long as the individual unlawfully disseminating restricted data had "reason to believe that the data will be utilized to injure the United States or to secure an advantage to any foreign nation."

"Reason to believe" is, if anything, a more cryptic phrase than those examined above. Lawyers, however, are soothed by such jargon, which serves to convey ideas more deeply felt than understood. "Reason to believe" must parallel in meaning the judgment of the ordinary reasonable man—a standard somewhat lacking in objective exactitude, but one to which men learned in the law instinctively turn.

It is fair to predict that prosecutions grounded on dissemination with "reason to believe" are most likely to be directed against scientists who inadvertently publish restricted data in a journal or monograph; against journalists publishing such data in newspapers; and against anyone having the misfortune to misjudge the character,

the loyalty, or the discretion of another to whom he has communicated restricted data. But these, by hypothesis, are all innocent men —that is to say, innocent of any deliberate intent to engage in treasonable activities. At most they may be indiscreet. It is justifiable to punish carelessness and indiscretion concerning atomic data with severity, since data so revealed are as dangerous to the national security as those given away by deliberate treason: nevertheless, punishment should be limited to those who have been guilty of carelessness and indiscretion, and this guilt should be demonstrable by objective standards.

Since one may infer that data in the restricted category are per se deemed capable, if improperly disseminated, of inflicting injury on the United States or conferring an advantage on a foreign power, proof that the data communicated lay within the restricted category would no doubt create the presumption that they were conveyed with "reason to believe" they would inflict injury on the United States or confer an advantage on a foreign power.

A scientist engaged in private research in nuclear physics must keep fully informed regarding all interpretations and regulations issued by the Commission pertaining to the scope of restricted data. Only by so doing can he ascertain whether or not he is free to publish the results of his research. However, since it is manifestly impossible for the Commission to list even by title each category and subcategory of information subsumed under the definition of restricted data, partly because of the dimensions of the task and partly for reasons of security already mentioned, the private scientist can never be certain that the information he intends to publish lies outside the scope of restricted data. In questionable cases, therefore, he would be well advised to submit his report or monograph to the Commission for security clearance before publication. The Commission should establish a staff unit to review promptly all material submitted for this purpose.

Consider, now, two possibilities. If the Commission decides the data are free of security restrictions, that ends the matter and the scientist is free to publish his findings in any way he sees fit. But if there is a ruling that the research findings contain restricted data,

the scientist who has discovered the information cannot publish it. This, to be sure, cannot end the matter, else science would soon expire for lack of circulation and interchange of life-giving ideas. The scientist in question will find it necessary to communicate his findings to colleagues, in the United States, of course, who are engaged in the same work and therefore have a vital interest in any advances that are made. At this point our scientist is compelled to embark on a perilous venture. For while he is not forbidden from communicating restricted data to others, he must not only avoid exposing himself to a charge of acting with intent to injure the United States or to give an advantage to any foreign nation but he must also be careful that he is not open to a charge that he had reason to believe that these consequences might result from his acts. In theory, at least, an innocent man would run little risk of being charged with an intent to injure the United States or advantage a foreign country, but anyone communicating restricted data must regard the "reason to believe" provision as a treacherous bog in his path. A scientist who communicates restricted data to his colleagues must be certain that they are loyal, trustworthy, and nonsubversive; that they are fully acquainted with the control of information section of the Atomic Energy Act and with regulations relating to restricted data issued by the Commission; and that, in addition to being loyal and versed in the law, they are also discreet and keep good company.

This is, unfortunately, not a neurotic caricature of what the scientist faces when, in the interest of scientific progress (or for any other reason), he takes it upon himself to impart restricted information. For it is easy to see that anyone whose transmission of restricted data turns out badly must face the possibility of prosecution for communicating information with "reason to believe" that injury to the United States or an advantage to a foreign nation would result because the recipient of the information was (as would be alleged) well known for his "disloyal views," "subversive tendencies," "reputation for indiscretions," "disloyal acquaintances," etc. It is, in other words, insufficient to guard one's own morals; one must also judge the loyalty, patriotism, and discretion of those with whom one communicates—even the colleagues and associates in one's own

laboratory—and run the risk of imprisonment if this judgment should prove erroneous.

Procedural Provisions of Section 10

Commission Must Be Advised before Criminal Action Taken

Violation of any of the prohibitions just reviewed is a criminal offense, subject to prosecution in the federal courts. Ordinarily all such prosecutions would be brought by the local United States attorney subject to some internal supervision by the Department of Justice in Washington. The Atomic Energy Act, however, contains a novel provision directing that no prosecution be commenced except upon the direction of the Attorney General, and then only after the Attorney General has advised the Commission with respect to the prosecution [Section 10(b)(5)(A)].

The Senate report explains this provision as "an assurance to scientists working in atomic energy fields that prosecutions would not be initiated without review by persons having the technical and scientific background necessary to determine the significance of the acts complained of." * The House debates over the legislation suggests a further reason for this provision.† Congresswoman Helen Gahagan Douglas, in urging defeat of the House Military Affairs Committee's efforts to delete the provision, justified it as an essential safeguard against precipitate action by local United States attorneys, guaranteeing a "cooling-off" period during which, it is to be hoped, the more detached judgment of the Attorney General could be obtained. "A scientist's reputation," as Mrs. Douglas said, "is severely injured by the mere initiation of prosecution, regardless of whether or not he is ultimately acquitted." Scientists, now that their work has cast them into the volcano of controversy, must unfortunately expect to be the victims of the universal tendency to hasty judgments that are almost impossible to eradicate by rational evidence. As the old saw has it: People think last what they thought

* Senate Report No. 1211, Seventy-ninth Congress, Second Session (1946), p. 24.

† 92 Congressional Record 9470 (1946).

first. The Commission, as a matter of simple justice apart from the dictates of enlightened self-interest, must not overlook any steps that would tend to reduce the risks to reputation and personal freedom that scientists working in atomic energy will face. Nor can it afford to disregard wholly the statement made by a group of the leading nuclear physicists that, unless they could continue their work in peace, they would abandon their preoccupation with the inanimate atomic nucleus and turn their energies to the study of Lepidoptera, a more secure if less exciting activity.

Investigation of Personnel

As a further means of protecting restricted data, the Act contains unique provisions to assure the integrity of personnel working on atomic energy matters. All contractors and licensees of the Commission are required to agree in writing not to permit any individual to have access to restricted data until an investigation of the "character, associations and loyalty of such individual" has been made by the FBI and a determination made by the Commission that access by such person will not "endanger the common defense or security" [Section 10(b) (5) (B) (i)]. It may be noted that disregard of this clearance is only a breach of contract, not a criminal violation. Of course, if restricted data should in fact be illegally communicated, the contractor or licensee might be guilty of conspiracy [Section 10(b) (2) (A)], but additional evidence would undoubtedly be required to sustain such a charge.

For Commission employees, the Act requires an FBI investigation *before* hiring [Section 10(b) (5) (B) (ii)]. Such investigations for government employees are customary and are often completed before the employee reports for duty. However, the provision making prior investigation a statutory requirement is unprecedented. Some flexibility is afforded the Commission in the power to hire without waiting "in case of emergency."

To bridge the temporary period in which investigations are being conducted, any individual permitted access to restricted data by the Manhattan District may be allowed to continue in this position of privilege and any present or former employee of the Man-

hattan District may be employed by the Commission [Section 10(b)(5)(B)(iii)].

One point merits emphasis. For all employees of the Commission as well as employees of contractors and licensees the final determination as to qualification for employment, including such elements as character and loyalty is made by the Commission. Where it has been the practice of a Federal agency to have the FBI investigate and report, the final determination in each case has been left to the employing agency's discretion. While in the majority of instances the Commission would undoubtedly reject an applicant for employment if the FBI commented on him unfavorably, it would be a dangerous precedent to subordinate the judgment and authority of the agency responsible for the program to that of the FBI.

Use of Services of Other Agencies

To assure that all possible steps are taken to prevent unlawful dissemination of restricted data, including the physical guarding of property and equipment, the President is expressly authorized to use the services of all government agencies "to the extent he may deem necessary or desirable" [Section 10(b)(5)(B)(iv)]. This must be taken to refer especially to the monitoring and policing facilities of the military departments during the transition period while the Manhattan District was being taken over by the Commission and before the Commission had been staffed to perform these functions independently.

Inspections and Records

Section 10(c), relating to inspections, records, and reports, is self-explanatory and requires little comment.

The Commission is expressly authorized to require reports to be made and records to be kept of atomic research under Section 3 and of licensed activities under Section 7 of the Act. It is also authorized and directed to inspect such activities on its own initiative "as may be necessary to effectuate the purposes of the Act." With respect to the production of fissionable material incident to research, the Com-

mission is directed to make *frequent* inspections and to require reports and records.

These provisions serve the dual purpose of enabling the Commission to perfect its control over these activities, and of assuring that the Commission is promptly informed of new developments in the study, manufacture, and use of atomic energy.

The Information Section and the Espionage Act

Earlier in this chapter, it will be recalled, reference was made to Section 10(b)(6), which provides: "This section shall not exclude the applicable provisions of any other laws, except that no government agency shall take any action under such other laws inconsistent with the provisions of this section." The phrase "applicable provisions of any other laws," while general, must be read as pointing particularly to the Espionage Act.

Until the adoption of the Atomic Energy Act, and thus throughout the entire period of World War II, the Espionage Act, passed in June, 1917, and subsequently amended, was the only statutory source of the controls invoked to protect data concerning the atomic bomb, the production of fissionable material, and the very existence of the Manhattan Project and all its activities. In the earliest stages of drafting legislation for the development and control of atomic energy it was realized that the provisions of the Espionage Act were unsuited in several respects for dealing with the secret data of theoretical and applied nuclear physics. The control of information provisions of the Atomic Energy Act were not merely designed to plug certain gaps in the Espionage Act; they were designed with the object of satisfying so far as possible the desires of scientists who would have to operate under the law to escape the stultifying restrictions on the exchange of information to which they had been subjected by the Manhattan District. Although in certain respects more comprehensive and more stringent than the Espionage Act, the Atomic Energy Act provided a framework within which the scientists felt they had some chance of operating effectively, however hazardous their personal lives might become. They were con-

vinced that an extension of the information practices of the Manhattan District, based on the Espionage Act, would in the long run have smothered all creative activity in the field of nuclear research.

If, therefore, Section 10(b) (6) is so construed that the Espionage Act remains in force for private research as well as governmental activities, the scientists have, indeed, sustained a crushing defeat and the more moderate and enlightened information provisions of the Atomic Energy Act are little more than pietisms. It is reasonable to assume that no such interpretation will be imposed; nevertheless, there remains a formidable problem in integrating and reconciling the provisions of the two Acts. For the Atomic Energy Act clearly cannot be considered to have supplanted the Espionage Act and, on certain major points, the two measures appear to be directly in conflict. Skillful administration and careful judicial consideration will be needed to reconcile the apparent inconsistencies and to effect the evident intent of Congress, regardless of the labyrinth of confusion that inadequate drafting has created.

To arrive at the heart of the difficulties it is necessary now to examine the provisions of Title I of the Espionage Act and to show, step by step, where conflicts may arise between the two laws and how these may be reconciled without doing violence to either.

Mechanics of the Control System in the Espionage Act

Information Respecting the National Defense

At the outset, one may note the fact that, while the information section of the Atomic Energy Act makes some effort to define the crucial subject matter of "restricted data," the only reference to this subject in the Espionage Act is the phrase "information respecting the national defense." A review of the judicial decisions (which are meager) and of the legislative history (which is inconclusive) furnishes both a negative and a positive criterion for evaluating "information relating to the national defense." *United States v. Heine* * seems at least to establish the principle that "information relating

* 151 F. (2d) 813 (C.C.A. 2nd 1945).

to the national defense" cannot be information publicly available. The opinion goes on to say that the information must be "secret" although the term is not precisely defined.*

The legislative debates on the Espionage Act furnish ground for concluding that only "official secrets" were intended to be covered by the Act. Vague as this term is, it is, nevertheless, of considerable importance in defining the scope of the Espionage Act and in reconciling apparent conflicts with provisions of the Atomic Energy Act, as will appear presently.

The other leading court decision under the Espionage Act (*Gorin v. United States* †) is not conspicuously helpful in defining "information relating to the national defense." National defense is stated to be a "generic concept of broad connotation referring to the military and naval establishments and the related activities of national preparedness." ‡ Evidently this is not Ariadne's thread to guide us out of the labyrinth.

Types of Offenses and the Prescribed Penalties

A. Section 1(a) § of the Espionage Act recites an offense for which there is no counterpart in the Atomic Energy Act—that of entering upon any government installation (*e.g.*, vessel, aircraft, navy yard, arsenal) or upon any other restricted territory vital to the manufacture, shipment, etc., of military equipment (*e.g.*, coaling station, canal, railroad, factory) or upon any other place "connected with the national defense, owned and constructed, or in progress of construction by the United States . . ." for the purpose "of obtaining information respecting the national defense with intent or reason to believe that the information to be obtained is to be used to the injury of the United States, or to the advantage of any foreign nation. . . ." By Section 6, the President is given power in time

* This case is more fully considered in Appendix F.

† See Appendix F.

‡ 312 U.S. 19, 28 (1940).

§ Note that the numbers here given for sections of the Espionage Act are the familiar ones used in Public Law No. 24, Sixty-fifth Congress [H.R. 291]. In Appendix E, where Title I is reprinted, the United States Code numbers are used instead, with the following correspondence: Sections 1(a)(b)(c)(d)(e) of the Public Law = Sections 31(a)(b)(c) of the United States Code, etc.; Section 2 = Section 32; Section 3 = Section 33; etc.

of war or national emergency to designate any place other than those set forth above as a "prohibited place" for purposes of this title ("*Provided* that he shall determine that information with respect thereto would be prejudicial to the national defense").

The prohibition, insofar as it relates to "entering upon" the places named, is in all respects unaffected by the Atomic Energy Act. Its primary interest for this discussion lies in the fact that the large majority of the places named are federal installations or places directly involved by contract or otherwise with the Federal government in activities relating to the national defense. This tends to strengthen the interpretation of the Espionage Act as being concerned mainly with government-owned or government-produced data.

The offense of "obtaining information" relating to the national defense from any such place as distinguished from that of entering upon prohibited places for the purpose of obtaining such information in a measure overlaps Section 10(b)(3) of the Atomic Energy Act. Prosecutions involving "restricted data" (which might also be considered as "information relating to the national defense") would, therefore, in all probability invoke the authority of the Atomic Energy Act, if for no other reason than that the maximum penalties under this Act are death or life imprisonment in one set of circumstances and twenty years' imprisonment or a fine of $20,000 in another, as against a maximum of ten years' imprisonment and a $10,000 fine in any circumstance under the Espionage Act.

Note, however, that under the Espionage Act "obtaining information" with "reason to believe" that it will be used to injure the United States or benefit any foreign nation is an offense punishable no less severely than if intent were proved, while there is no counterpart for this offense in the Atomic Energy Act. Which law will prevail if the restricted data of atomic energy are involved? A judicial decision is evidently required to settle the issue. But from all the circumstances we conclude that the omission of "reason to believe" from Section 10(b)(3) of the Atomic Energy Act, in light of the use of the same term elsewhere in the Act, was a deliberate omission on the part of Congress, whence it follows that a prosecution under Section 1(a) of the Espionage Act for obtaining restricted data on

atomic energy "with reason to believe," etc., would be contrary to the intent of Congress.

B. Section 1(b) provides a maximum of ten years' imprisonment and a fine of $10,000 for the offense of copying, making, taking, or obtaining—or inducing or aiding another to do so—any specified thing like a document, sketch, blueprint, etc., of anything connected with the national defense, with intent or reason to believe that the information is to be used to the injury of the United States or to the advantage of any foreign nation. This offense is similar to that for which Section 10(b)(3) of the Atomic Energy Act provides severe penalties. A distinction of which much has been made lies in the fact that the Espionage Act forbids the acquisition *of documentary information only,* while the Atomic Energy Act seals this crevice by adding the phrase "or information." We are not unduly impressed by the point. It is at least open to conjecture whether anyone obtaining information based on one of the documents, models, plans, etc., listed in Section 1(b) of the Espionage Act would be immune to prosecution. Suppose, for example, "A" memorizes or induces another to memorize the contents of a map or document * containing information respecting the national defense, intending to use such information to the injury of the United States. It seems doubtful that such an action would be immune from the operations of the Espionage Act. Again, it should be noted that the Espionage Act, unlike the Atomic Energy Act, makes the action under discussion punishable if performed "with reason to believe," as well as "with intent." The comments on this point under (A) above are applicable here.

C. Section 1(c) applies the same penalties as those of Section 1(b) to offenses involving any of the above-mentioned kinds of documentary information, when committed by anyone knowing or having reason to believe that the documentary information has been or will be used by any person contrary to the provisions of the Act. This is a curious provision substantially overlapping Section 1(b) and has no counterpart in the Atomic Energy Act.

* There come to mind at least two famous fiction cases involving these circumstances: "Mr. Memory" in John Buchan's *39 Steps;* A. Conan Doyle's *The Bruce-Partington Plans.*

D. Section 1(d) is of particular importance and is, therefore, given in full:

> . . . whoever, lawfully or unlawfully having possession of, access to, control over, or being entrusted with, any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or note relating to the national defense, willfully communicates or transmits or attempts to communicate or transmit the same to any person not entitled to receive it, or willfully retains the same and fails to deliver it on demand to the officer or employee of the U.S. entitled to receive it . . . shall be punished by a fine of not more than $10,000, or by imprisonment for not more than 10 years, or both.

There is no counterpart for this provision in the Atomic Energy Act, but it needs to be considered in relation to Section 10(b)(2). First, there are the usual differences in the severity of the punishment, already mentioned above. Second, Section 1(d) makes no reference to intent to injure the United States or give advantage to any foreign nation; nor, of course, is there mention of the accompanying circumstance of "reason to believe." The Atomic Energy Act, on the other hand, enumerates offenses under both attendant circumstances in Sections 10(b)(2)(A) and 10(b)(2)(B). The language of Section 1(d) of the Espionage Act is "willfully communicates or transmits or attempts to communicate." Without entering upon a legal-semantic analysis of the word "willful" and its uses in the law, it is fair to infer that as used in Section 1(d) it has a more sweeping effect than "intent" and "reason to believe" combined. What is probably intended by the word as used in this context is a *flat prohibition* against communicating, transmitting, etc., *regardless of intent or reason to believe.* The only exempted communications would be those made under duress or in a somnambulistic state or by an insane person. This interpretation of the intent of the provision is strengthened by the fact that what is prohibited is the communication, etc., *"to any person not entitled to receive it,"* etc.

Section 1(d) omits the word "information" from its catalogue of prohibited transmittances and communications—an omission to

which some significance may be attributed in view of the inclusion of the word in Sections 1(a) and 1(e) [see below]. Shall Section 1(d), therefore, be limited in interpretation to control over the disposition of documentary information or other vehicles incorporating data related to the national defense? We think not, partly for the reasons given in (B) above and partly because of the language of the Act itself. It is made unlawful to "communicate" documents, models, sketches, plans, etc. Since physical objects clearly cannot be imparted by "communication," the provision becomes meaningful *only* if the prohibition extends to the information contained or incorporated in the document, model, sketch, plan, etc., as well as to the physical objects themselves.

The legislative history of the Espionage Act * only partly supports the view that Congress believed information contained or incorporated in the objects listed to be under the same interdict as the objects themselves, even though the word "information" was omitted from Section 1(d). The word was included in earlier drafts of the bill,† and when a draft omitting "information" was brought to the floor of the Senate, the omission was questioned. Senator Overman, managing the bill on the floor, stated that, in the opinion of the draftsmen, express inclusion of "information" was unnecessary because the bill was already broad enough to cover it: "I think everything is covered in the bill without putting in those words here. The Committee thought that those words are unnecessary in this place." ‡

It may be admitted that this does not immediately resolve all doubts; nevertheless, the balance of the evidence, logical, philological and historical, appears to support the view that "information" lies within the scope of Section 1(d), even though not specifically mentioned.

Section 1(d) prohibits the communication or transmission of any document, etc., "to any person not entitled to receive it," and makes an offense of "willfully" retaining such a document, etc., or failing

* See Appendix F.

† S. 8148, Sixty-fourth Congress, Second Session (1916); S. 2, Sixty-fifth Congress, First Session (1917). See also Appendix F.

‡ 55 Congressional Record 778.

"to deliver it on demand to the officer or employee entitled to receive it." This is by far the strongest element in proof of the proposition that, at least so far as communication and transmission of data are concerned, the Espionage Act is intended to control only official government secrets. The use of the bare phrase "entitled to receive it," unqualified by any other standard for determining what class of persons is thus entitled, points to the conclusion that only "officers and employees of the United States" subject to the procedures for classifying authorized persons applied by their own agencies could have been intended, and to the further conclusion that the subject matter involved could only be official government secrets or government information.

Here again, the legislative history is inconclusive. The corresponding section of H.R. 291, one of the parent bills of the Espionage Act, was expressly limited to information "belonging to, intended for, or under the control of the U.S." S. 2, another parent bill, also referred to "information belonging to the government, or contained in the records or files of any of the executive departments . . . to which no person unless duly authorized shall be lawfully entitled." On the other hand, the absence of any such clear-cut language in the Espionage Act itself may lead to the inference that the term "information" is not of such limited scope.

In *United States v. Gorin* * the court, in holding certain other sections of the Espionage Act constitutional, said that "information relating to the national defense" is not too vague a description of forbidden subject matter, in view of the fact that to obtain a conviction under the sections involved it was necessary to show that the offender had mischievous intent or had "reason to believe" that the consequences of his actions would adversely affect the national defense. But in Section 1(d) neither intent nor "reason to believe," etc., need be proved. From the reasoning in the Gorin case, it would appear that Section 1(d) would be unconstitutional if construed to make a criminal offense of the mere "willful" communication of "information relating to the national defense" without either intent to injure the United States (or advantage any foreign nation) or

* 312 U.S. 19 (1940); also see Appendix F.

reason to believe that such would be the consequences of the communication, since the vagueness of "information relating to the national defense" would not be offset by a requirement that *intent* be proved. On this principle, a conviction under Section 1(d) for communication without "intent" and without "reason to believe" could be sustained only if the vague and essentially undefinable concept of "information relating to the national defense" is construed, *so far as Section 1(d) is concerned,* to mean information, say, "belonging to the government, or contained in the records or files of any of the executive departments." For on that interpretation, even if intent (or reason to believe) were lacking, the prohibited information would be so clearly describable that one could not plausibly assert that Section 1(d) failed wholly to meet the necessary standards of definiteness and comprehensibility required for penal statutes.

E. Section 1(e) describes the offense of misdelivering or losing any document, plan, code, book, photograph, model, or information "relating to the national defense," etc., or of "permitting the same to be removed from its proper place of origin . . . or to be stolen, abstracted or destroyed . . . *through gross negligence.*" The offender must be one "entrusted with or having lawful possession or control of" any such information, documentary or otherwise. The maximum punishment is ten years' imprisonment, or $10,000 fine, or both. Observe that neither intent nor reason to believe are ingredients of this offense: it is predicated upon gross negligence. Observe further that it clearly is limited to officials or employees of the government (including government contractors), since persons in this class would be "entrusted with or have lawful possession or control of" the information in question. It is conceivable that someone not in this class might have "lawful possession," etc., but this would be the rare and exceptional case.

There is no provision of the Atomic Energy Act corresponding to Section 1(e). Section 10(b)(4) describes, among others, the offense of "mutilating or destroying" any document, etc., containing or incorporating restricted data, but intent to injure the United States or give advantage to a foreign nation must be an attendant

circumstance. The offense is not limited to persons "entrusted with or lawfully in possession or control of" the restricted data.

It is clear that the offense described in Section 1(e) of the Espionage Act is applicable to the restricted data of atomic energy, but judicial determination is required to describe the *class of persons* to whom its prohibition extends. In our opinion, this class includes government officials, employees, and contractors—anyone officially entrusted with restricted data by an executive department of the Federal government and perhaps anyone working on a project financed in whole or in part by federal funds. But it is our judgment that private, nonfederal activities in the field of atomic energy (research and development, industrial, etc.), are not within the scope of Section 1(e). The loss, for example, through gross negligence of restricted data (information relating to the national defense within the meaning of the Espionage Act) by a scientist engaged in private research in nuclear physics would *not* be a punishable action within the meaning of Section 1(e) of the Espionage Act. On the other hand, if a government scientist loses, through gross negligence, a document with which he has been entrusted containing restricted data within the meaning of the Atomic Energy Act, he would certainly be liable to punishment under Section 1(e) of the Espionage Act.

F. Section 2(a) provides a maximum penalty of twenty years' imprisonment for the communication or transmittal (or inducing another to do so) of any specified thing like a document, sketch, etc., or of *information* relating to the national defense to the government, or a representative or subjects, of any foreign state. The action must be taken with "intent or reason to believe that it [the information] is to be used to the injury of the United States or to the advantage of a foreign nation." The same offense, committed in time of war, is punishable by death or by imprisonment for not more than thirty years.

This is the gravest offense described in the Espionage Act, as may be inferred from the severity of the punishment. The same offense would be covered by Sections 10(b)(2)(A) and 10(b)(2)(B) of